NOV 30 1928

McGraw-Hill Publishing Company, Inc.

November 29, 1928

Engineering News-Record

Devoted to Civil Engineering and Contracting

STABILIZING PLUM POINT REACH OF THE MISSISSIPPI RIVER

By RAMEY WILLIAMS—*A historic episode in the long effort to control the Mississippi River is reviewed, and an experienced riverman's views on a highly controversial subject are presented*

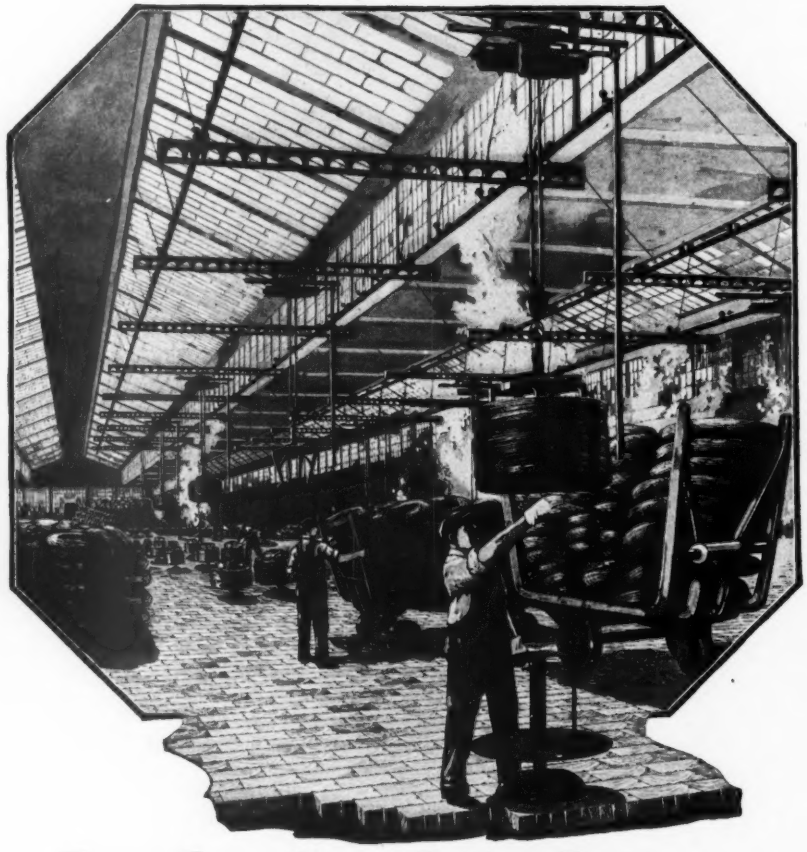
ALSO

Facing a 90-ft. Cut With Concrete
Cored-Out Pipe Piles Used in Sticky Clay
Combating Ice at Hydro-Electric Plants in Norway
Unusual Design of a New Theodolite
Replacing a Railway Span at a Congested Site
Tests of Curing Methods for Concrete Road Slabs
Relative Use of Streets by Pedestrians, Vehicles and Street Cars

ut of Liberty Bridge
h Being Faced
ete

KREOLITE

"Outlast the Factory"



In the Steel Industry

Where heavy materials are being handled and large loaded trucks are transported from one department to another, Kreolite Wood Block Floors withstand the continuous strain to which they are subjected. Laid with the tough end grain uppermost, they are resilient, easy on the workmen's feet, and afford the maximum of strength, endurance and economy.

Our Kreolite Engineers will study your floor needs and make recommendations without any obligation on your part.

THE JENNISON-WRIGHT COMPANY, TOLEDO, OHIO

Branches in All Large Cities

WOOD BLOCK FLOORS

New York, November 29, 1928

Engineering News-Record

A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

F. E. SCHMITT, *Editor*

Editorial Staff
New York
M. N. BAKER
C. S. HILL
W. G. BOWMAN
H. W. RICHARDSON
V. T. BOUGHTON
Managing Editor

Editorial Staff
Chicago
E. E. R. TRATMAN
W. W. DE BERARD
San Francisco
N. A. BOWERS

WILLARD CHEVALIER
Publishing Director

Contents

Volume 101, Number 22, November 29, 1928

Facing a 90-Ft. Cut With Concrete 794

BUILDING the north approach to the Liberty bridge in Pittsburgh involves the placing of 10,000 cu.yd. of concrete. By C. K. Harvey

Structural Aspects of the St. Louis Tornado 797

COMMITTEE of engineers and architects describes failures of material and recommends certain types of construction.

Record Precipitation and Wind Reported From Porto Rico ... 798

IN THE STORM of Sept. 13, 1928, Weather Bureau records 160-mile wind velocity and rainfall of more than 25 in.

Cored-Out Pipe Piles Used in Sticky Clay 799

DIFFICULT FOUNDATION JOB recently completed near Catskill, N. Y., by new method after other methods fail. By Oscar J. West

Stabilizing the Plum Point Reach of the Mississippi River 801

PERSONAL OBSERVATIONS of the original work at different times during 47 years, and conclusions on efficiencies. By Ramey Williams

Combating Ice and Low Temperature at Norway Hydro Plants 805

METHODS of overcoming ice troubles at spillways and intake racks, and repair of roller gate sill at Raanaasfos. By Oren Reed

Unusual Design in New Theodolite 806

GEODETIC SURVEY instrument for precision work embodies many new ideas and passes test satisfactorily. By Douglas L. Parkhurst

Replacing a Railway Span at Congested Site 809

RENEWAL made without interrupting Pennsylvania Railroad traffic in and out of Pittsburgh.

Test of Curing Methods for Concrete Road Slabs 813

HALF WIDTH of road cured by earth and water, other half divided into twenty sections and each cured differently. By D. D. McGuire

Relative Street Use by Pedestrians, Vehicles and Street Cars ... 814

BELT LINE surrounding Denver business district located after ascertaining by count the actual use of street area.

Editorial 791

Letters to the Editor 816

News of the Week 819

Construction and Equipment Materials 824

Business Side of Construction 826

McGRAW-HILL PUBLISHING COMPANY, INC., TENTH AVENUE AT 36TH STREET, NEW YORK, N. Y.

NEW YORK District Office, 285 Madison Avenue
WASHINGTON, National Press Building
CHICAGO, 7 South Dearborn Street
PHILADELPHIA, 1600 Arch Street
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie Street, London, E. C. 4

JAMES H. McGRAW, Chairman of the Board
MALCOLM MUIR, President
JAMES H. McGRAW, JR., Vice-President and Treasurer
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
HAROLD W. McGRAW, Vice-President
C. H. THOMPSON, Secretary

Publishers of
American Machinist — Engineering News-Record
Power — Chemical and Metallurgical Engineering
Coal Age — Food Industries — Radio Retailing
Engineering and Mining Journal
Ingeniería Internacional — Electric Railway Journal
Bus Transportation — Electrical Merchandising
Electrical World — Construction Methods
Electrical West
(*Published in San Francisco*)
American Machinist—European Edition
(*Published in London*)

SUBSCRIPTION PRICES: United States and its possessions, Canada, Mexico, and other countries taking domestic postage rates, $5 a year. All other foreign countries, $8 a year. Single copy, 25 cents. Published weekly. Entered as second class matter, April 11, 1917, at the Post Office, New York, N. Y., under the act of March 3, 1879. Printed in U. S. A.

Copyright, 1928, by
McGraw-Hill Publishing Company, Inc.

CHANGE OF ADDRESS

Subscribers are requested to send both the old address and the new address when they move to a new address.

Member—Audit Bureau of Circulations.
Member—Associated Business Papers.

Construction Market Place, 128 — Searchlight Section, 108 — Index to advertisers, 136 — Directory of Consulting Engineers, 104

Number of Copies Printed This Issue, 31,864

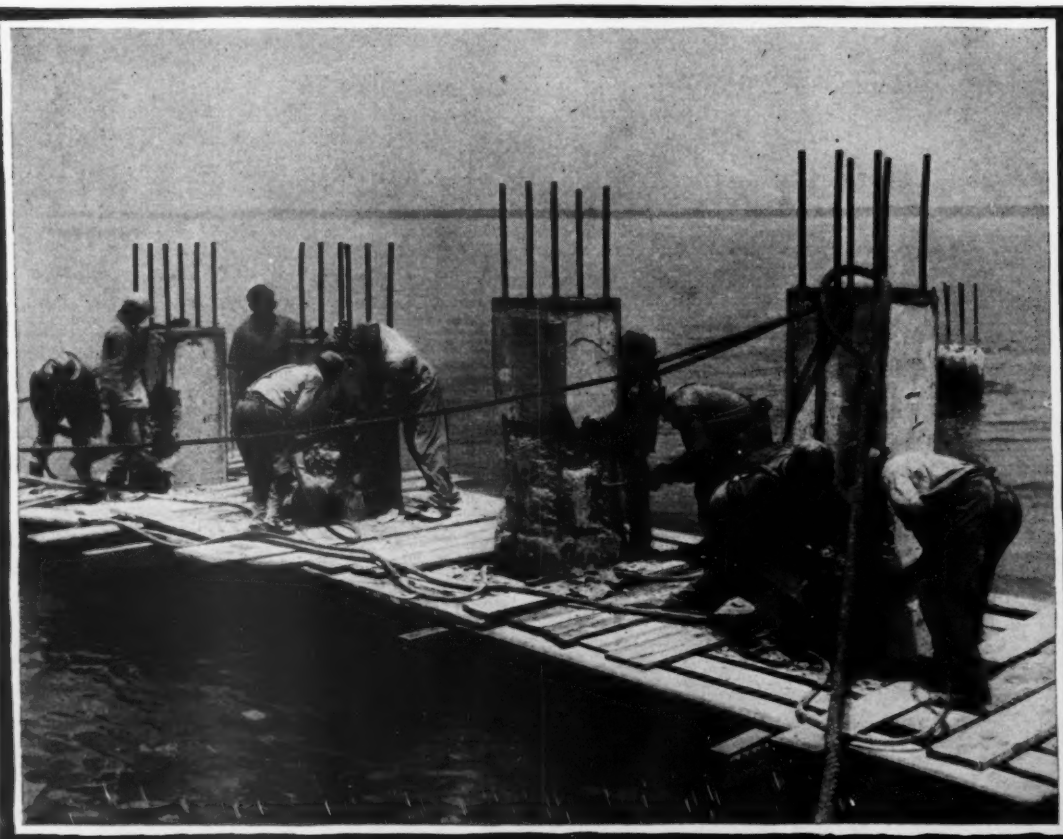
RAYM

Every once in a while some super-sized reinforced concrete job must be done quickly...some job requiring unusual organization and equipment...some job typical of what Raymond is doing right along,...and Raymond is ready to undertake the full

RAYMOND CONCRETE PILE COMPANY

NEW YORK - 140 Cedar St. CHICAGO - 111 West Monroe St.

Raymond Concrete Pile Co., Ltd., Montreal, Canada



ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGRAW-HILL PUBLISHING COMPANY, INC.
JAMES H. McGRAW, *Chairman of the Board*
MALCOLM MUIR, *President*
EDWARD J. MEHREN, *Vice-President*
H. C. PARMELEE, *Editorial Director*

F. E. SCHMITT, *Editor*

WILLARD CHEVALIER
Publishing Director

Volume 101 NEW YORK, NOVEMBER, 29, 1928 Number 22

Stormproof Buildings

EVERY windstorm, whether it be hurricane or tornado, leaves in its wake much unnecessary structural damage. Engineering reports after each of the major storms of recent years have made this fact plain. And in so far as the report of the engineering board on the St. Louis tornado of September, 1927, given elsewhere in this issue, is a description of the damage done, it is only a repetition of what we have known before—namely, that most structural failures in any storm are directly attributable, first, to a failure to appreciate the value and absolute necessity of tying together every part of a structure, and second, to shoddy methods of construction. But this report goes farther. It analyzes the various structural failures in the light of probable type of storm action causing them, thus arriving at some approximation of the kind of forces which must be resisted—explosive action, direct wind pressure and the impact of flying débris. This is a most commendable method of approach. The work of the St. Louis board is of high value in pointing the way to better practice. It confirms the belief that present skill, methods and materials, if but applied rightly, are entirely adequate to the erection of stormproof buildings.

Flying Débris

THAT windborne débris was one of the three major causes of structural failure in the St. Louis tornado, and specifically that signboards were leading contributors to this hail of destruction, is something which invites serious reflection. Many past experiences showed that objects carried by winds of tornado violence may be driven against fixed objects with unbelievable force; hardly a storm of this character occurs without some freak example of this force being reported. But that such flying débris can be a major factor in the general destruction has not heretofore been so clearly indicated as in the St. Louis studies. Recent developments in connection with the Florida hurricane of two months ago add weight to the findings at St. Louis. In Florida it has been shown that the steel sash of large windows, which had first been assumed to have failed under wind pressure alone, actually were battered in by flying objects, as were also some large steel rolling doors. As to the source of the flying débris, general building wreckage is doubtless a large contributor, but in St. Louis the count against signboards is particularly heavy. Civic authorities have long opposed signboards because of their unsightliness, their inherent danger as obstructions and various other undesirable features, but these objections, while weighty, concern the signboard only in its normal, quiescent state. Danger to life, limb and property caused by a signboard in flight during a storm is a far more serious charge. Even though there may be small possibility of eliminating signboards altogether, it is a proper demand that they should be built stable and strong enough to be wind- and storm-proof. Allowing them to become missiles of destruction during a storm is sheer neglect of civic responsibility. It is the engineer's duty to think of signboards as stormproof structures and to foster a similar conception on the part of municipal authorities so that it may soon become mandatory that they be designed and erected to meet that conception.

A Bit of River History

SELDOM does one get as accurate a word picture of the vagaries of the Mississippi River as is given in Ramey Williams' account of the attempts to stabilize Plum Point Reach, printed in this issue. In fancy he takes his reader back some twenty-odd years to show him what the Reach was like when the stabilizing work had progressed to a point where it was confidently expected that it would be effective. And when the reader has formed a conception of what that stretch of the river was like he is brought up to the present day and the trip is repeated in order to show how much the river has digressed from the channel in which it was supposed to be stabilized. The picture which Mr. Williams paints is a true one, but it should not be taken as conclusive evidence that the Mississippi River cannot be stabilized. As he indicates, the federal government has never followed a consistent policy of providing funds as regularly as would be required to follow out a comprehensive long-range plan. Here, as elsewhere, vast sums have often been wasted through failure to follow up year by year the gains made previously. Neglect, through lack of funds, has made much stabilizing work ineffective. Until stabilization work on the Mississippi is permitted to go ahead in an orderly way over a long period of years we never shall have conclusive evidence of the real effectiveness—or, perhaps, utter uselessness—of the undertaking.

Obsolescence

A STRIKING example of the uncertainty of rules for determining the useful life of structures is given in the present razing of the twelve-story Pictorial Review Building at the corner of Seventh Ave. and 39th St., New York City, to make way for a 30-story building for the garment trade. Built less than a decade ago, this structure was the last word in buildings for the publishing business. The region then seemed destined to be a center of publishing activities. The structure was substantially built, with high dead- and live-load allowances to permit of its being used chiefly for printing plants. Recent developments, however, have transformed the area. Seventh Ave. below 42nd St. has become the center of the garment trade. Land values have increased enormously, and whole blocks which were largely occupied by low-grade stores and dwelling houses are now occupied by great loft buildings devoted to the garment-making industry. Increasing demand for land on Seventh Ave. put so high a value on the Pictorial Review corner that its sale became inevitable. The building is

now being torn down to make way for a structure more than twice as high. The present owners claim that razing the building is cheaper than attempting to add to its height or altering it to suit a different trade. The building has become obsolete before one-fifth of what might well have been assumed to be its useful life has elapsed. What is the life of the great building investments in which the present generation is storing its savings? The question is as complex as it is important.

Better Concrete for Roads

BETTER concrete has been a constant objective since roadbuilders began to use that material extensively. By adopting rich mixtures and holding to them as invariable standards, and by giving the closest scrutiny to the ingredients, to their amalgamation in the mixer and to their placing and curing, they have applied a high quality of concrete to state and federal-aid roadbuilding. A further step is now being taken, to utilize skilled designing of mixtures. From now on, by recent announcement of the Bureau of Public Roads, concrete for roads built with federal aid must be proportioned by weight, must hold to the lowest water-cement ratio which will give a workable product, and must employ graded aggregates secured by combining separated sizes if necessary. These are exacting demands, but they are not out of line with the trend of practice. This year will see occasional road work for which concrete will be specified on a definite strength basis. Very nearly that refinement has been reached as general practice in a few states. Proportioning by weight is common, and the number of specifications is increasing in which definite limits are set on the water content. The pronouncement of the Bureau of Public Roads is nowise oppressive in the light of present knowledge of concrete mixture design. It is a recognition of the high ability reached by roadbuilders.

Construction and Schools

TIME was when the objective of the student entering upon a college engineering course was to fit himself to "practice" engineering design. Construction seemed to him a mere incidental of engineering, something carried out by laborers directed by a foreman. But since those days construction has gone through an evolution, and the contractor of today is its product. He developed as the size and importance of construction operations made engineering training essential, until it was necessary to have a competent engineering staff in order to carry on construction successfully. Many of the newer generations of engineers saw the opportunities in construction, moreover, so that today engineering, a most essential phase of the construction industry, permeates its organization most thoroughly. It is an encouraging sign, therefore, that construction men and engineering schools are coming into closer relationship. Incidental testimony to their increasingly closer contact appeared in a recent visit of a group of Portland contractors to Oregon's leading engineering school, on which occasion the students joined with the men of the construction industry in a program of technical discussions. Such contacts are helpful. It is equally helpful when a prominent member of the same group of contractors conducts a course of "engineering administration in construction" at that school. These things are indicative of progress in organization and training through which engineers and the construction industry jointly are putting their work on a higher plane.

State Materials Purchasing

BUILDING with materials furnished by the owner is one of the most ancient of construction practices. As construction increased in volume and structures grew in magnitude and as public works came to form a considerable part of construction, the purchase and supply of construction materials by the owner became more difficult; the builder assumed this function, and only rarely did the owner retain it. Within the last decade, however, the old procedure was revived, and curiously enough this occurred first in the field of public works, where its practice first had been abandoned. Resumption of owner-purchasing has been most marked in concrete construction. Today cement is being very commonly furnished for public works, and most often so in roadbuilding.

To measure its extent and to appraise the results, the Municipal Reference Bureau of Cincinnati recently made a count. It covered 41 states. An effort was made to extend the census into counties and cities, but the returns were meager. Of 41 states it is reported that nineteen have undertaken to furnish cement for road pavement and structures, but five of the nineteen have again abandoned the practice.

When state purchase and supply of cement for concrete road construction was first advanced for consideration several advantages were expected: (1) Better control of the material both in quality and in its incorporation into the structure, (2) saving in cost due to volume purchases, elimination of the contractor's differential as purchasing agent and ability to take every advantage of trade and cash discounts, and (3) increased competition and a reasonable certainty of better construction service because less capital would be tied up in material and more capital would be available for pushing production. In the replies to the Cincinnati bureau these reasons for the state purchase of cement continue to be named. With experience, however, there has come less certainty of the sureness of these benefits. The abandonment of the practice by five states reflects this clearly.

Of the fourteen states which still do purchasing, five furnish cement under some special conditions (such as buying for convict-labor road work, or guaranteeing cement price for the duration of the contract, or having a cement mill to keep busy). Only nine states purchase cement in the market and furnish it to contractors for road construction, and two of these nine are not wholly convinced of the merits of the practice. Seven states express their general satisfaction. In the light of such evidence, is it not worth while to review our thinking; is owner-purchase of materials fundamentally a sound construction policy?

One basic question is whether the state is a successful purchasing agent. The reports to the Cincinnati bureau are fragmentary. Of the fourteen states which have undertaken the straight state purchase of cement for contractors, only one makes positive claim of money saving. Four assert that no better prices are realized, one states that the contractor buys more cheaply, and all five of these admit delays in delivery. There is no comment on prices or delivery by the remaining states; from the records it must be assumed that they are satisfactory. At best, then, the records indicate only slightly more than an even chance that state purchase of cement gives better price and delivery, which are the vital tests of purchasing ability. Control of quality seems a stronger argument for state purchase. Obviously there is in-

creased certainty and convenience of control when all sources of supply and direction of delivery are centralized. But to counterbalance this the state has to assume responsibility not only of control but of quality.

And here we confront the final and perhaps crucial question. Is it in the interest of efficient road construction to remove the responsibility of the contractor, or should we strive to organize contractual relations in such way as to keep definite responsibility for results centered upon him? We think that the latter position has the advantage.

Where City Practice Lags

MEASURED by the standards of state road construction, inferior construction prevails in concrete street paving. City paving specifications exhibit general ignorance or disregard of the best concrete paving practice. These conclusions, developed through a survey of city paving by the engineers of the Portland Cement Association, constitute a severe indictment of city engineering.

The paving specifictions of 125 cities were studied. These cities were selected as those having the best practice, and they include cities in every state. The coverage therefore is country wide, and under the conditions of selection it is reasonable to assume that the practice represented is above rather than below the average.

Methods of measuring aggregates are the crude ones of the early days of concrete paving. Control of mixing water is recognized in about half of the specifications, but an adequate means of control is provided by only a few. All recognize the need of adequate mixing time, but only half contain requirements that will insure it. While more than half require longitudinal joints, only a moiety of these show an understanding of how the joints should be constructed. Most of the specifications concede the value of transverse joints, yet there is no agreement as to spacing or construction. As to reinforcement, in only a few cases is the weight of the steel co-ordinated with the transverse joint spacing.

Turning now to construction procedure, only five specifications require the use of finishing machines, though 58 indicate that they may be used. Only a few specifications describe precisely how the fine finishing shall be done. Only 25 cities prohibit the storage of aggregates on the grade. Less than 30 per cent of the specifications recognize the value of part-at-a-time construction. Subgrade templets are required in only 52 cities, and in only 25 is their proper use defined. The curing requirements are generally adequate, but they are not properly enforced.

The count is disheartening. Not one of the requirements of design that are neglected would increase the cost greatly; nor, indeed, would the correction of the construction faults be expensive. No state highway department countenances the poor design and the sloppy workmanship of city paving, and yet the unit prices for state roads compare favorably with those paid by the cities.

It is not because prices are less that city paving is inferior. It is so because city-paving engineering shows lack of knowledge of good concrete practice. With all that ten years has taught the builders of roads, city concrete paving generally clings to antiquated and obsolete procedure. It is high time that city-street engineering shook off its lethargy and became conscious of the advance that is being made in other fields.

Equalizing Business

WHEN the so-called "prosperity reserve" bill was before Congress last winter, we spoke hopefully of the lofty economic thought embodied in the plan of making public works serve as a balance-wheel to equalize the ups and downs of business activity—which means the people's wellbeing, since the idleness attendant upon depressions brings want and misery. Carrying farther the idea which there was applied to federal works, Governor Brewster, of Maine, at the instance, it is said, of President-elect Hoover, last week proposed to the conference of Governors that similar reserves of public moneys and public-works needs be created by the states.

The very proposal of such an idea is of brilliant significance to our economic progress. It means that the great paradox of the modern industrial world—the constant threat that want may grip us because we produce too efficiently and abundantly—has found such clear recognition as to be given a leading place in public discussion. From such discussion, beyond doubt, the ultimate solution of the baffling paradox is to be expected.

It would be idle to deny that there are serious, almost insurmountable, difficulties in the way of application of the idea. There are difficulties in planning and selection, in financing and in due adjusting of the desired remedial action to economic conditions. Public works, like private works, are responses to definite needs and are undertaken when these needs arise; to defer the satisfaction of those needs is as undesirable, and as difficult to determine upon, in public as in private affairs. Financing is more difficult in hard times and means an increased burden of interest charges; but it is still harder to contemplate the alternative, to arrange the financing long in advance of necessity and thus either by earmarking pre-empt a certain amount of credit, or else actually issue public obligations and pay interest on idle money.

Today we are in a period of active production and consumption, as all statistics show. Shall Los Angeles therefore defer its San Gabriel flood-protection dam, New York its subway construction, Chicago its water and sewage-treatment improvements, or Iowa its roads? Just as well may we ask that the United States abandon the Mississippi control enterprise until hard times are in prospect. We shall not find it easy to agree, in any event, on what to build now and what to defer.

And there will be at least equal difficulty in deciding on the moment when shrinkage or hard times are in the offing. Stock Exchange fevers and Federal Reserve rates surely cannot serve as criteria! And as to employment figures or contract lettings, we may look back just a year to a time when so many complaints and conflicting claims as to unemployment were current, and yet a most active year was ahead—a year which did not need the undertaking of reserved public works to maintain production and exchange on a sound basis.

If such difficulties militate against placing the Brewster project within the range of practicality for the present, they should be only the greater incentive toward wide public study of the problem at issue. The war moved us forward a half-century in general appreciation of economic relationships by the masses, and today we can count on useful public reflection upon questions which fifteen years ago were the field of a few special students. If we utilize this power of the popular intellect to penetrate into the complexities of the plan of equalizing business by reserved public works, we may confidently look forward to a sound ultimate conclusion.

Facing a 90-Ft. Cut With Concrete, Liberty Bridge, Pittsburgh

Slope Wall Built Between Gravity Walls at Toe and Crest—Elaborate System of Pipe Drains and Weep Holes Provided—Ready-Mixed Concrete Used

By C. K. Harvey

Assistant Engineer, Bureau of Bridges, Allegheny County, Pittsburgh, Pa.

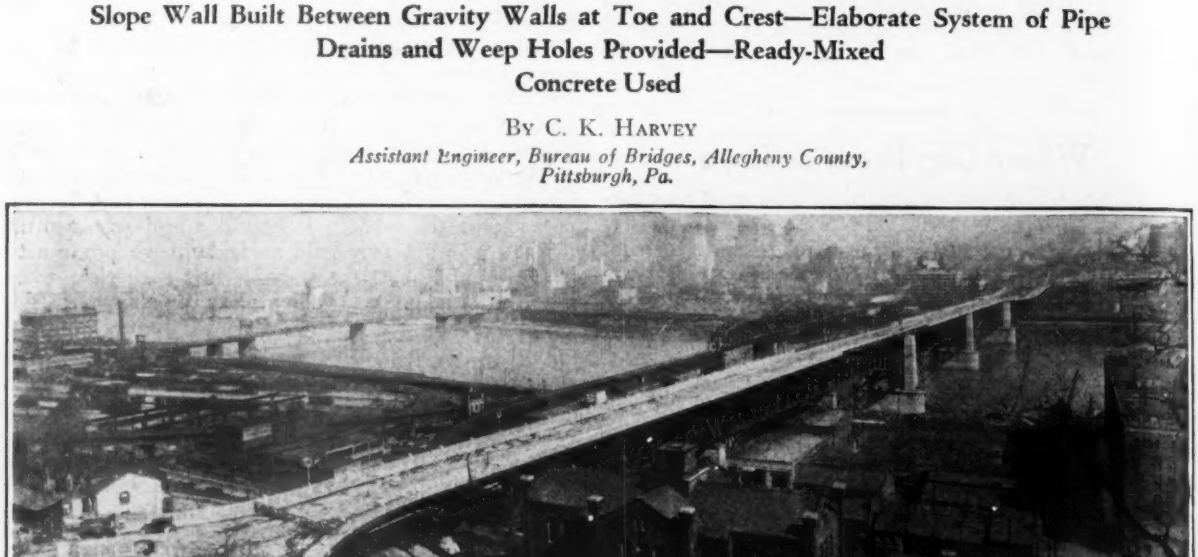


FIG. 1—LIBERTY BRIDGE, PITTSBURGH, PA., LOOKING TOWARD NORTH APPROACH CUT

A 90-FT. cut involving the excavation of 185,000 cu.yd. of earth and rock and the placing of 10,000 cu.yd. of concrete in retaining and slope walls to hold the high face was required in building the north approach to the Liberty bridge in Pittsburgh, Pa. Except for handling the spoil in the congested business district, where the work was located, the excavation presented no exceptional problems. There was, however, an unusual problem in facing the high cut slope with concrete so as to secure a well-appearing structure and one that would hold the steep face and care for its drainage. Its solution by the engineers of the Allegheny County Department of Public Works is described here.

Liberty Bridge—The new Liberty bridge affords a direct connection from the north end of the Liberty tunnels to the downtown district of Pittsburgh and, with the tunnels, completes a thoroughfare about 10,000 ft. long and costing $9,500,000, which gives quick access to and from the suburban districts south of the Monongahela River. The bridge proper, as shown by Fig. 1, is a deck structure 2,663 ft. long and consists of approach spans of various lengths crossing above five streets and the tracks of three railroads and of two main spans over the Monongahela River, each 470½ ft. center to center of piers. The main roadway is 38 ft. between curbs, widened to 93 ft. toward the north end to provide for two connections at grade (each 19½ ft. wide) to the Boulevard of the Allies and the underpass roadway 43 ft. 10 in. wide to Forbes St. The sidewalks are 8½ ft. wide. The paving consists of a concrete base with asphaltic concrete surfacing. The grade on the bridge is 1.6 per cent and that on the underpass to Forbes St. is 4 per cent, both descending northward. The handrailing is of malleable iron and was described in *Engineering News-Record*, April 19, 1928, p. 618. The design and erection of the superstructure will be described in detail in a future article. The substructure is of concrete except that the river piers have granite facing for a height of 10 ft. at the water line. The river piers were carried to rock about 45 ft. below pool full by pneumatic caissons.

North Approach Cut—The construction of the north

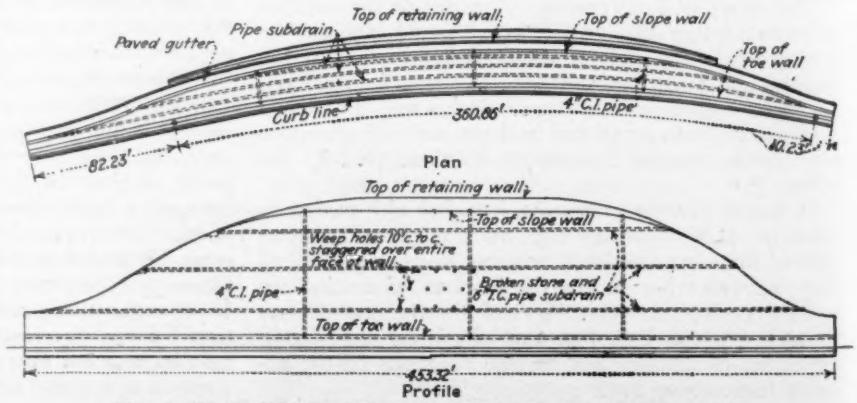


FIG. 2—PLAN AND PROFILE OF APPROACH CUT SLOPE WALL

approach, 834 ft. long from Forbes St. to the Boulevard of the Allies, was in itself a considerable project, involving the removal of 185,000 cu.yd. of excavation, a large part of which was rock, and the placing of nearly 10,000 cu.yd. of concrete in retaining walls and slope walls in addition to the paving. The maximum depth of cut was about 90 ft. A considerable part of the rock was material suitable for making brick and was stored by the contractor for future use for that purpose. The material was excavated by steam shovel and was disposed of by trucks.

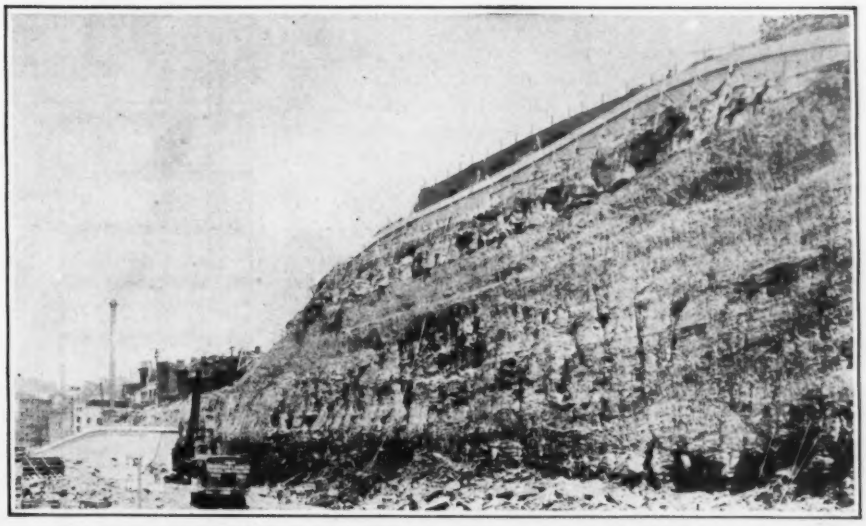


FIG. 4—APPROACH CUT EXCAVATION NEARLY COMPLETED
Note rough surface of the rock slope. Retaining wall at top completed and construction of toe wall just begun.

Slope Wall Structure—An elevation and plan of the retaining and slope walls are shown by Fig. 2. Details of the wall are shown by Fig. 3. A cut was first made to the level of the base of the upper gravity retaining wall, which was then constructed from above. Excavation was then continued to the lower level and the rock scaled to a slope of 4 on 1 (Fig. 4), after which the heavy gravity wall at the base was constructed. The slope wall was then built in sections, as shown by Fig. 5, using steel forms for the face. The ready-mixed concrete used in the slope and other walls was brought to the site in ½-yd. drop-bottom buckets from a plant 1½ miles away and was deposited in the forms by two cranes, one of which was of the tractor type with a 50-ft. boom, and the other a locomotive crane on trucks with a 90-ft. boom. These cranes were also used in handling and placing the steel forms for the face of the slope wall.

Drainage for the slope wall was provided by four horizontal lines of 6-in. vitrified pipe covered with broken stone and discharging into vertical 4-in. cast-iron pipe embedded in the wall. (Figs. 2 and 3.) Between the top of the slope wall and the base of the upper retaining wall a concrete gutter provides for surface drainage. Five 4-in. weep holes in each wall section take care of water not finding its way into the cast-iron pipe system. The total height of the walls and slope protection is 91½ ft.

The slope was trimmed with bull points and due to the nature of the material, which varied from limestone through several varieties of shale to coal and which broke and sloughed off very irregularly (Fig. 4), the thickness of the slope wall varied from 30 in. to 6 ft.

Slope Wall Construction—The forms were held in place by suspending them from a row of the 1-in. bolts referred to later, so located as to be 1 ft. below the tops of the buckstays. At the bottom they were wired to the projecting reinforcing rods of the section of wall immediately below and were shored up by 6x6-in. timbers placed against the wall face and resting at the bottom in the gutter of the lower gravity wall.

In placing the concrete, great care was taken to spade it and work it thoroughly against the form. An air hammer was in constant use against the face of the steel form to prevent honeycombing. In the shallow sections the form was filled slowly to avoid arching. The forms were removed in about 24 hours and the surface of the wall was rubbed down with carborundum stone. It was found that honeycombing averaged about ⅓ per cent, usually occurring at the panel strips. One to two sections were poured each day, the total number of sections being 59. All of the concrete was 1:2:4 mix.

After completion, the surface of all exposed concrete was treated with two coats of magnesium fluosilicate for hardening. The first coat consisted of ½ lb. of magnesium fluosilicate to the gallon of water and the second of 2 lb. to the gallon, the first coat covering 100 sq.ft. to the gallon and the second 150 sq.ft. The solution was applied by spraying.

After the rock face had been cut to the required slope, holes were drilled for 1-in.

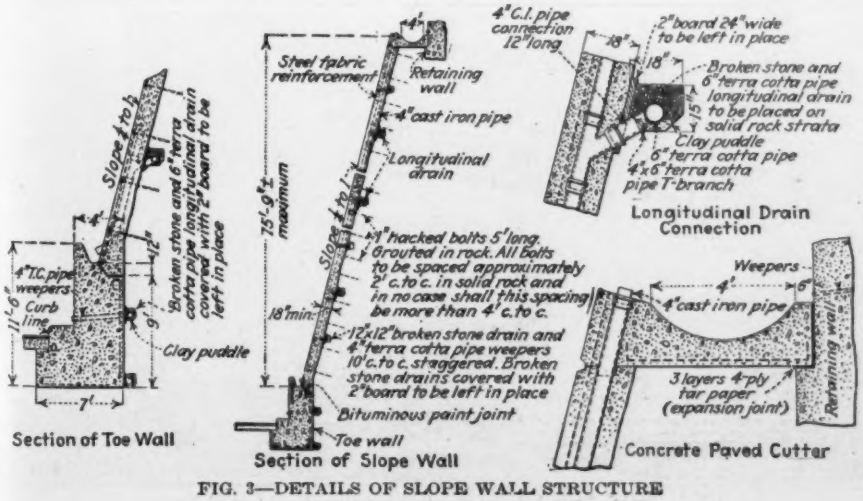


FIG. 3—DETAILS OF SLOPE WALL STRUCTURE

anchor bolts 5 ft., 8 ft. and 9 ft. long spaced 2 to 3 ft. on centers both ways. These bolts were grouted in place, with a projection from the rock face, and were provided with nuts and 6-in. diameter plate washers, the latter engaging the fabric reinforcement, which was placed 6 in. from the face of the wall. This fabric was of welded steel wire 4 in. on centers both ways, of equal section in both directions and weighing 158 lb. per 100 sq.ft. After placing the drainage system and protecting the broken stone surrounding the vitrified tile pipe with a 2-in. plank, the concrete was poured directly against the rock face.

The slope wall was poured in sections 16½ ft. high and varying from 24 ft. to 25 ft. in length. Alternate sections in each horizontal tier were first poured and the omitted sections then filled in, as shown by Fig. 4. Keys (6x6 in.) were provided in the edges of each section.

Details of Forms—The steeel forms used for the outer face of the wall were 20x25¼ ft. over all. The framework consisted of nine horizontal pairs of 2½x2x¼-in. angles, 1 in. back to back, spaced 2 ft. on centers. The $\frac{5}{16}$-in. plate for forming the masonry face was attached to the 2-in. legs of these angles with countersunk bolts. Vertical buckstays were provided, consisting of twelve pairs of 6-in. 8.2-lb. channels, held 3 in. back to back with pipe separators every 5 ft., spaced 2 ft. on centers. The buckstays were attached to the horizontal pairs of angles at each intersection by means of hook bolts engaging a bolt passing through the angles, the nut of the hook bolt drawing against a 6x3x½-in. batten plate on the outstanding flanges of the buckstay channels (Fig. 6). Steel bulkheads 18 in. in depth were bolted at each end of the form to confine the concrete. In practice, due to the varying thickness of the wall, it was necessary to supplement these with timbering.

Provision was made for the attachment to the buckstays of 8x8-ft. working platforms, as shown in Fig. 6. These platforms were made up of 6-in. 8-lb. channel floor stringers and a $\frac{5}{16}$-in. floor plate, with knee braces of two 2½x2x¼-in. angles, and angle handrailing posts drilled for the attachment of a 2-in. plank railing.

Engineers and Contractors—The bridge was designed by and constructed under the supervision of the Allegheny County Department of Public Works, Norman F. Brown, director. The north approach work was in charge of the bureau of roads, E. A. Griffith, chief engineer, and the remainder of the project under the bureau of bridges, V. R. Covell, chief engineer. All material was inspected by the bureau of tests, P. J. Freeman, chief engineer. The contractors were as follows: River piers, Dravo Contracting Company; land piers and abutments, Vang Construction Company; north approach, Booth & Flinn, Ltd.; superstructure, Independent Bridge Company. The architectural features were supervised by S. L. Roush, county architect.

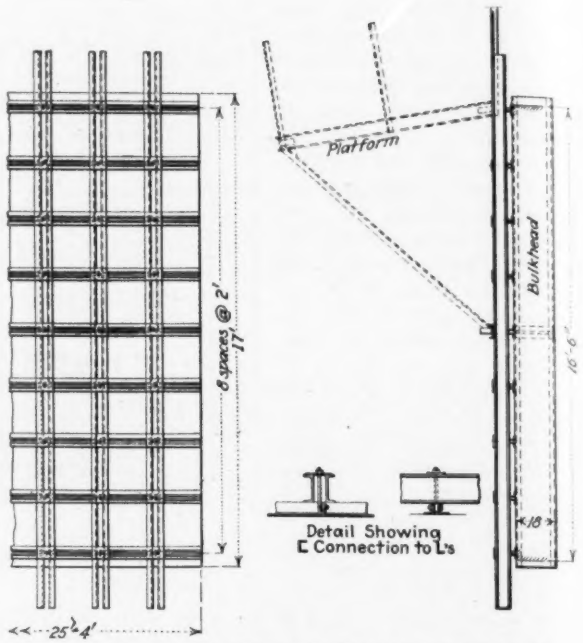


FIG. 6—DETAIL OF STEEL FORMS FOR SLOPE WALL

Engineers Will Visit U. S. on Way to Japan

While on a recent visit to London, O. C. Merrill, secretary of the Federal Power Commission and general chairman of the American section of the World Power Conference, issued an invitation to European engineers intending to be present at the World Engineering Conference to be held in Tokyo, Japan, next year to be the guests of American engineers while en route. The invitation was received very favorably. Arrangements will be made to have the European engineers visit various well-known engineering projects in the United States.

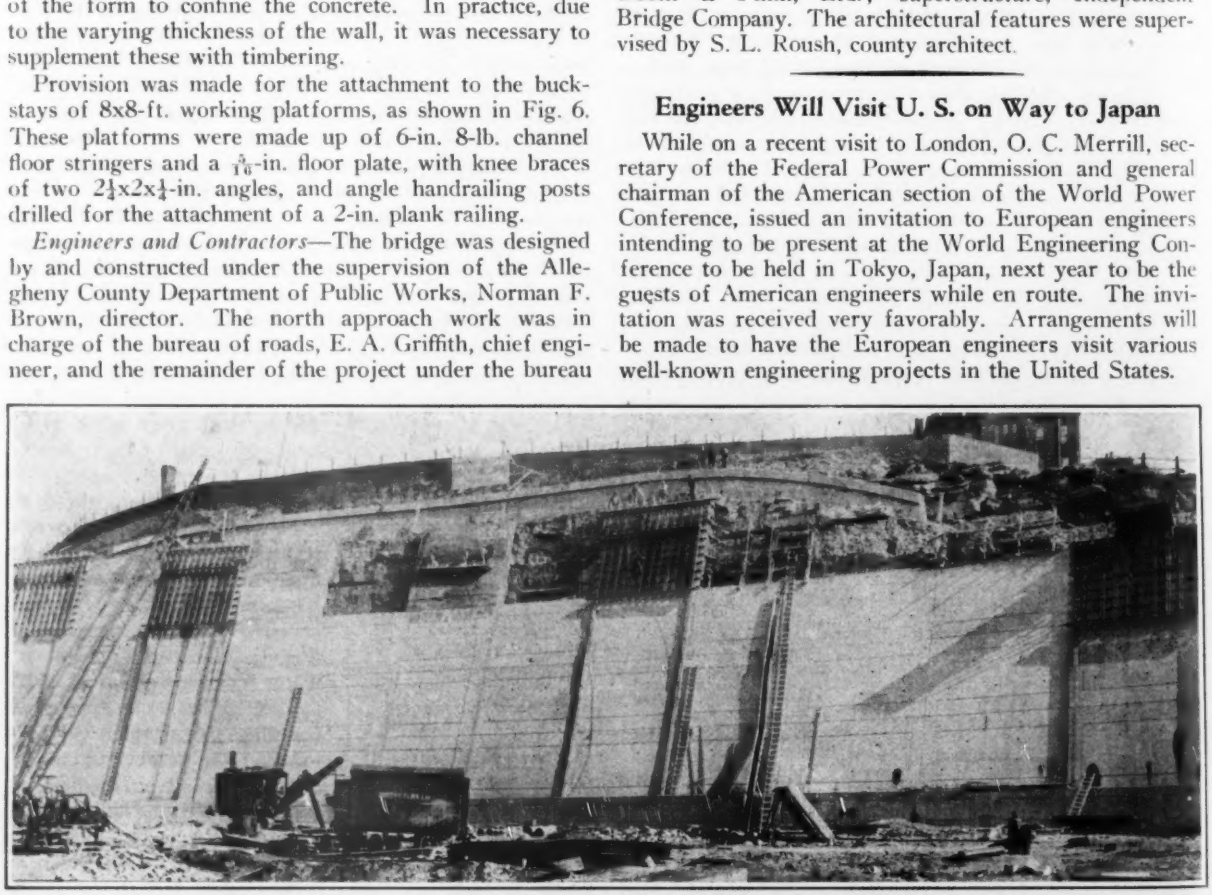


FIG. 5—CONCRETING THE 75-FT. SLOPE WALL

Structural Aspects of the St. Louis Tornado

Committee of Engineers and Architects Reports on Storm of Sept. 29, 1927—Poor Construction Prevalent

THE TORNADO which passed over the city of St. Louis on Sept. 29, 1927, caused damage to buildings to an amount of approximately $25,000,000. A detailed account of the structural damage was given in *Engineering News-Record*, Oct. 6, 1927, p. 558. The following information is taken from a report made by a joint committee of the Engineers Club of St. Louis and the St. Louis Chapter, American Institute of Architects, which has studied the structural damage. It points out observed characteristics of the tornado action, describes typical structural failures and recommends certain types of construction as proof against all but the worst of tornado winds.

—EDITOR.

THE STORM of Sept. 29, 1927, covered a path about 20 miles long, 8 miles of which was within the city limits of St. Louis. This path varied in width from 300 to 6,000 ft., the greatest damage being done in a 200-block area of a residential section of the city. The storm moved in a northeasterly direction.

Characteristics of the Storm—Weather reports show that on Sept. 29 St. Louis lay in the southeastern quadrant of a low-pressure cyclonic area, a position generally considered favorable for the formation of tornadoes. A violent thunderstorm preceded the tornado. A wind velocity of 96 m.p.h. was registered at the U.S. Weather Bureau station 3 miles from the tornado center, and there was an instantaneous fall in the barometer from 28.91 to 28.80 with a quick return.

An eyewitness of the storm, the late Dr. Clifford H. Farr, professor of botany, Washington University, stated that the funnel was about 600 ft. in diameter at the base, twice as wide at the top and perhaps 800 ft. high. Boards and other objects were observed coming out of the top of the funnel or from near its upper margin. Following the passage of the funnel-shaped cloud, the wind blew directly toward it, as evidenced by the bending of the trees.

The committee concludes that "there was a central whirl to the storm, revolving in a counterclockwise direction, and that this took the usual form of a funnel-shaped cloud with its lower tip shifting about like an uncontrolled fire-hose under pressure, moving from side to side, lifting from the earth and returning with freakish abandon."

Structural Failure—The action of the storm upon structures resolves itself into three main heads: (1) Explosive effect of unbalanced pressure within closed structures due to the sudden drop in atmospheric pressure at the core of the tornado; (2) effect of direct wind pressure upon exposed surfaces in zones of varying width on either side of the tornado path; (3) damage from flying débris.

From the explosive action windows burst outward with such force that broken glass was hurled a considerable distance. In the poorer types of buildings entire walls were pushed out, allowing the roofs and floors to drop. Roofs which housed closed air-spaces were removed almost intact. Unlined chimney flues in exterior walls burst open, hollow walls had the outside facing removed and suspended ceilings burst downward. Side by side with this damage light picket fences and chimney pots which would have easily toppled over from high wind pressure were undamaged. The bursting out of windows probably saved many walls, as did the failure of some other weak spot in the walls.

The wind velocity near the center of a tornado probably reaches 400 to 500 m.p.h. over a small area, and it is not expected that any economical construction can be made to withstand the forces which result, says the committee. However, in the strips of varying width on either side of a tornado where direct wind pressures of high intensity prevail buildings constructed to withstand wind pressures ordinarily specified in the building code will not be greatly damaged.

Flying débris constituted a serious source of damage, particularly to wires, windows and roofs. Damage from this source can be prevented only by more adequate construction and by the prohibition of temporary structures such as signboards, etc.

The buildings in the damaged area represented almost every type of construction. Factories, churches, schools, retail shops, garages, warehouses and car barns were in the area, although dwellings predominated. No material could be called a failure, although this could not be said of the combination of materials. There was little, if any, effort made to anchor flat roofs to the walls, the rafters being laid into the walls, which were topped with 9-in. parapets. The walls themselves were laid in lime mortar of generally poor quality and offered no resistance to any lateral action caused by pressure from within or without. Hipped roofs were not damaged as much as flat roofs. It is the committee's opinion that this was probably due to the larger volume of confined space in these roofs, which allowed the air to expand without great damage. Slate and tile suffered about equally, both being blown off on the windward side of roofs. Wood shingles were readily blown away. Asbestos shingles were blown but not cracked. Composition shingles of rubber or asphalt withstood the storm more satisfactorily but were found to be badly bent. Metal roof covering was rolled off by the wind after it had been lifted from its nailing. Hollow cornices exploded and in numerous cases were blown off. Porch roofs where confined space existed between roof and the ceiling were observed to have expanded. Box cornices were subject to similar action.

Comparatively speaking, more masonry walls were destroyed at points where floor joists were laid parallel to walls than at points where they rested directly on the walls. In the former case the walls were usually not anchored to the joists. Innumerable examples of the fallacy of calling a wall three half-brick in thickness a 13-in. wall were found; in practically every case it consisted of an 8-in. wall, more or less bonded, with a brick facing standing conspicuously alone and with practically no tie to the backing wall. Diagonal headers as anchors were conspicuous failures. In nearly all cases it was noticeable that the vertical joint between backing and face brick had not been filled with mortar.

Recommendations—(1) Mortar for all masonry work above the grade line should not be inferior to one composed of one part portland cement, one part lime putty and four parts clean sand.

(2) Header courses should be used for bonding walls, and diagonal bonding brick should be prohibited. The use of metal wall ties should be limited to types approved by the building department.

(3) Combination walls of brick and hollow tile should have a bond equal to that required by the building code for brick walls. This applies equally well to combinations of stone and brick, or terra cotta and brick, or to walls containing air spaces.

(4) Flue linings should be used in all chimneys for rigidity.

(5) Structural steel frames should be connected into a rigid framework. Wood or steel joists, corrugated iron, asbestos shingles, rib-lath or precast cement tiles should be securely fastened to the individual structural members.

(6) Spandrel walls and decorative elements should be effectively and permanently anchored to the frames.

(7) Joists laid parallel to walls should be anchored every 6 ft. to the walls, and the anchors should extend through the second or third joist. Interior partitions should be anchored to the masonry walls and should also be tied together at their intersections.

Record Precipitation and Wind Reported From Porto Rico

Weather Bureau Records 160-Mile Velocity Before Losing Instrument—Maximum Rainfall Exceeds 25 Inches

OBSERVATIONS recorded at the office of the U. S. Bureau in San Juan, Porto Rico, and at other points on the island during the hurricane of Sept. 13, 1928, are given in a report to the Weather Bureau by Oliver L. Fassig, meteorologist in charge of the Windward Islands for the bureau. Although the figures cited are admittedly imperfect, they add appreciably to present knowledge of hurricane conditions.

First warning of the disturbance was received on the morning of Sept. 11 from Washington. Further reports received during the day indicated that the center of the storm would pass close to Porto Rico, and radio warnings were broadcast from the naval station at San Juan at intervals of two hours starting at 8 p.m. on the 11th. The news was likewise telegraphed to police stations and other agencies of information throughout the island. At the same time the usual warnings to shipping were given. The storm broke over the southeastern portion of the island early on the morning of the 13th. The path of the storm center as it moved across the island at the rate of about 13 m.p.h. is shown in Figs. 2 and 3. After leaving the island the storm center apparently kept its initial course, speed of movement and intensity until it reached Florida, when the path turned to the northwest, then northward and northeastward.

FIG. 1—METEOROLOGICAL DATA SHOWING EFFECT OF HURRICANE
All curves based on records of U. S. Weather Bureau station at San Juan except barometric curve at Guayama.

Barometer Readings—At the San Juan station the barometer, as the center of the storm passed to the south at 2:30 p.m., registered a low reading of 28.75 in. (28.81 in. reduced to sea level). Other low readings throughout the island are given in Fig. 2. The extreme low was recorded at Guayama, on the southeast coast, where the barometer at 2:30 p.m. registered 27.50 in. (27.65 in. sea level). Guayama, Cayey and Aibonito reported a period of calm or light winds lasting from 20 to 30 minutes, indicating that the storm center passed over these towns. As a reading of 27.72 in. was reported at West Palm Beach, Fla., it would seem that the intensity of the storm remained about the same throughout a distance of approximately 1,700 miles.

Rainfall—Rainfall on the 13th and 14th was the heaviest ever recorded during 30 years of observation in Porto Rico. Records are imperfect, as a great many of the rain gages were overturned and, in addition, the great velocity of the wind made it impossible to register more than 50 to 75 per cent of the amount which actually fell. Rainfall plotted from the reports received is shown in Fig. 3. It will be noted that in two sections of the island the fall exceeded 25 in. for the duration of the storm. Adjuntas reported a phenominal fall of 29.60 in., a record which will be more carefully examined before being accepted.

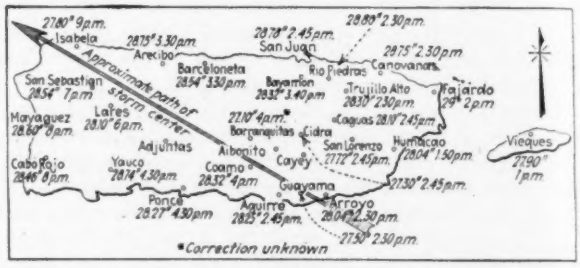


FIG. 2—LOW BAROMETER READINGS REPORTED SEPT. 13, 1928

Wind—Wind velocity observations at the Weather Bureau station at San Juan, about 30 miles from the storm center, recorded a maximum velocity (the greatest five-minute movement) of 150 m.p.h. and an extreme velocity (greatest one-minute movement) of 160 m.p.h. The anemometer used was of the three-cup type, which registers 30 per cent less than the four-cup type at velocities in excess of 100 m.p.h. and gives nearly true velocities. The maximum velocity registered was by no means maximum velocity attained during the storm, for at 11:44 a.m., shortly after the 160-mile figure was recorded, the instrument lost one of its cups. The wind velocity increased in intensity for three hours more, most of the damage to property at the weather station occurring between 2:30 and 3:30. Even with only two cups this instrument continued to register 75 miles per hour. At 12:47 p.m. a second cup disappeared, and the remainder of the instrument was lost at 1:33 p.m.

The area of the storm from east to west may be estimated from the fact that Guayama was in the vortex at 2:30 p.m. on the 13th. Winds of hurricane force prevailed from 4 a.m. to 10 p.m. of that date, a period of eighteen hours. Assuming a progressive movement of 13 m.p.h. for the storm, the area of winds of hurricane force east and west would be about 234 miles. The north-south extent of the storm is not known, as few reports were

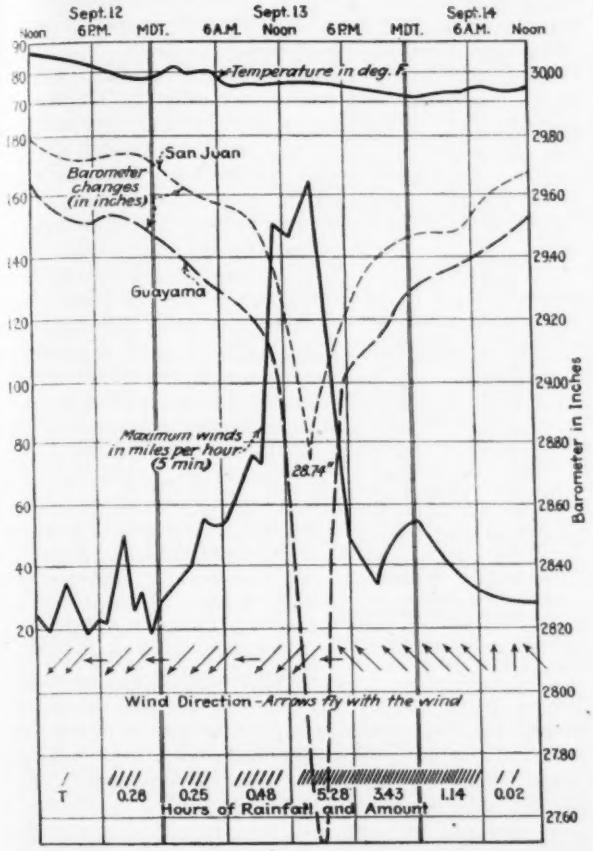


FIG. 3—RAINFALL CONTOURS FOR DURATION OF STORM

received from vessels at any time during the progress of the storm, indicating that the warnings sent out by the weather bureau had held them in port or kept them away from the danger zone. However, some points along the southern coast were apparently free from winds of hurricane velocity.

It is interesting to compare this storm with that of Aug. 8, 1899, which came nearest to approaching it in intensity. The paths of the two storms across Porto Rico were almost identical. A comparison of the two is given in the following table:

	Aug. 8, 1899	Sept. 13, 1928
Loss of life in Porto Rico	3,000	300
Lowest barometer reported (Guayama), in.	27.75	27.65
Lowest barometer at San Juan, in.	29.23	28.81
Duration of hurricane winds at San Juan, hours	3	12
Maximum velocity of wind at San Juan, m.p.h.	75	150+
Advance warnings of storm, hours	*18	36
Property losses	$20,000,000	$50,000,000
Greatest rainfall at Adjuntas, P. R., in.	23.00	29.60

*Owing to lack of facilities for prompt distribution of the warning to the rural population, the storm struck them unannounced.

The 1928 storm, although of greater intensity, resulted in only one-tenth of the loss of life which occurred in 1899. The reason for this, of course, is the speed with which storm warnings were transmitted to the populace of the island. Property damage was much greater, and detailed reports of the damage sustained will probably confirm the statement that this was the most destructive storm ever experienced in the West Indies. It is believed that the extremely low readings of the barometer and the unparalleled intensity of the wind experienced will substantiate this claim.

Cored-Out Pipe Piles Used in Sticky Clay

Jarring and Compression From Piledriving for Cement Silo Foundations Causes Piles Already Down to Rise

By Oscar J. West

President, Western Foundation Company, Chicago, Ill.

AN UNUSUALLY difficult foundation job was recently completed for the North American Cement Company at its Acme plant near Catskill, N. Y., involving piles for cement storage tanks. After trying several proved methods of installing cast-in-place concrete piles, the contractor successfully used a cored-out pipe method which he had developed experimentally but had not previously used in actual construction. The method of forming the cored-out pipe pile is shown in Fig. 2. An open-end steel pipe was driven to the rock surface, after which the pipe with the core of clay (Fig. 1) was withdrawn, the clay removed and the pipe redriven. At the time of the second driving, there was placed in the pipe a steel core with a cast-steel point which extended beyond the pipe. This core was driven to refusal, removed and the pipe filled with concrete. As the pipe was being filled with concrete, the core was used as a rammer, exposing the concrete to a pressure of approximately 75 tons; the outer pipe was withdrawn as the pressure was applied by the inner steel core.

Before trying the cored-out method several other pile installation methods had been unsuccessfully tried.

FIG. 1—A 16-IN. DIAMETER CLAY CORE REMOVED FROM THE CASING PIPE

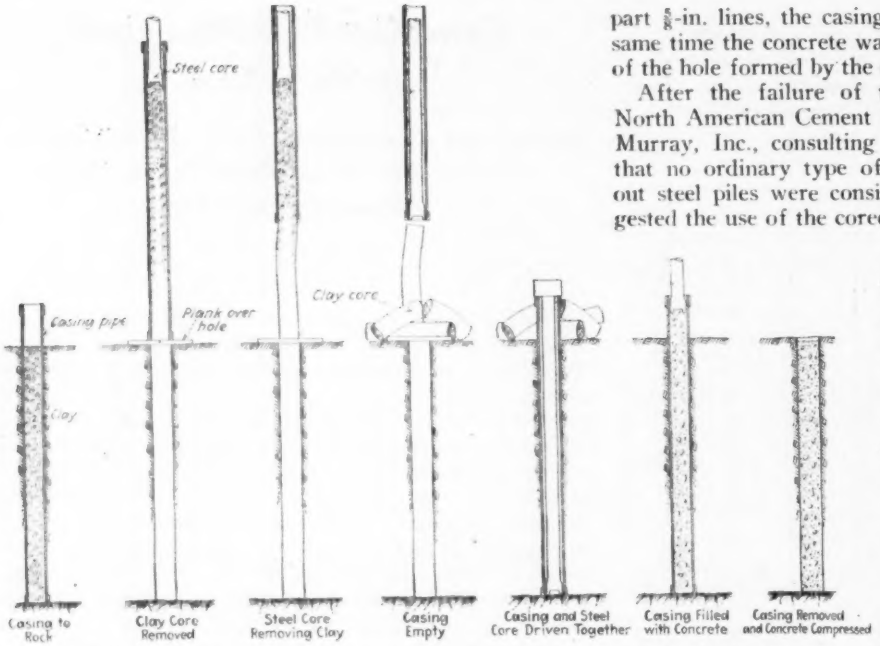


FIG. 2—STEP-BY-STEP METHOD OF FORMING THE CORED-OUT PIPE PILE

Borings had indicated rock at depths varying from 15 to 33 ft. below the pile cutoff, the overlying material being a comparatively soft clay which in the borings showed no unusual characteristics. Because of the unusually heavy load the foundations had to carry, it had been decided to use concrete piles, driven to rock 3 ft. on centers, at which spacing the piles would be subjected to a maximum load of 40 tons each. The contract was let on the basis of using a 16-in. compressed-concrete pile. About 70 piles of this type were driven in when it was discovered that the tops of the piles were rising several inches as additional piles were driven. As these piles were not protected by metal casing, an investigation was made to see if there was any deformation. There was none, but horizontal breaks were found and the contractors concluded that the uplift was in the upper part of the piles only.

A change was therefore made to a pile with a corrugated-metal casing. In driving these piles a mushroom or pedestal of concrete was driven out at the bottom, this mushroom being formed by raising the pile-forming apparatus about 12 in. above the rock and forcing out 8 cu.ft. of concrete. This it was thought would serve as an anchor in holding the pile down. However, after driving about 50 piles of this type it was found that they too were coming up and that the upheaval probably extended the entire length of the pile. It was seen when the clay dried out or froze that it was made up of thin layers with water between, and it was further conclusively demonstrated that the material was almost incompressible, so that any type of pile, either cast in place or precast, would rise off of the rock when additional piles were driven.

The driving apparatus used in making these two types of piles consisted of a 16-in. pipe $\frac{1}{2}$ in. thick, with an inner core pipe tipped with a steel casting. The outer pipe with its core was driven to rock, the core removed and the outer or casting pipe filled with concrete. The steel core was then placed on top of the concrete and by means of a pulling gear consisting of two ten-part $\frac{5}{8}$-in. lines, the casing was withdrawn, while at the same time the concrete was compressed against the sides of the hole formed by the casing.

After the failure of these two types of piles the North American Cement Company called in Thomas E. Murray, Inc., consulting engineer, and it was decided that no ordinary type of pile could be used. Blown-out steel piles were considered, but the contractor suggested the use of the cored-out pipe pile described above.

In driving the core pipe it was found that there were occasional stones or boulders overlying the bedrock. To avoid damaging the casing it was decided not to remove the core to rock, but rather to core out within about 18 in. of the rock surface, then after the steel core was replaced in the casing to drive both the core and casing together, either breaking the stones or pushing them out of the way. The first piles driven by this method were found to come up as much as $\frac{5}{16}$ in. As soon as this was discovered a chrome-nickel ring was welded to the bottom of the casing pipe so that it could be driven through the boulders to rock, thus coring out to the rock surface. In fact, since the underlying rock surface sloped about 30 deg., the consulting engineer recommended that wherever possible the casing be driven a short distance into the rock to prevent sliding. The McDonald Spencer Engineering Company, of New York, was the general contractor for the work. The foundations were installed by the Western Foundation Company, of Chicago.

Geological Survey to Study Well Drilling

A complete study of the problems involved in drilling and finishing wells is being undertaken by the U. S. Geological Survey under the direction of A. G. Fiedler. The importance of this subject is emphasized by the fact that fully half the people in the United States use water supplied by wells and that more than three-quarters of the cities and villages having water-works draw upon underground water supplies for domestic and industrial uses. The work will be supported by federal funds appropriated for the study of water resources of the United States, and it is estimated that it will require three years. Initially the investigation will be confined chiefly to those states, such as Illinois, Minnesota, North Dakota and Wisconsin, in which well-drillers' associations exist or are being formed. Results will be reported at the annual conventions of the well-drillers' associations and will also be published by the Geological Survey.

Roads and Trails Built in National Forests

Use of 10 per cent of the total receipts from timber sales, grazing fees and other national forest activities, supplemented by other road money appropriated by Congress, has made it possible to construct 1,538 miles of road and 6,462 miles of trails within or adjacent to the national forests during the last fiscal year. Including these figures, there have been completed in these areas a total of 14,823 miles of roads and 39,596 miles of trails.

Stabilizing the Plum Point Reach of the Mississippi River

Personal Observations of the Original Work at Different Times During 47 Years, Together With Conclusions on Efficiencies

By Ramey Williams
Memphis, Tenn.

CONTROL. WORKS by spur dikes and training walls on the Mississippi River in Plum Point Reach are so frequently referred to as being a complete failure of the contraction type of control that Mr. Williams' account of this $12,000,000 experiment begun 47 years ago is timely. He saw the original work done, and has navigated over this reach ever since. He takes the reader over an imaginary trip when half the time from then to now has elapsed, and again over a similar trip last year. That experiment seems to have been a success during the first period and then to have been abandoned. Throughout the whole of the original article, of which the following extract is about one-third, Mr. Williams covers the vagaries of politics as well as those of the river, not omitting Mark Twain and his 1882 trip to renew his old acquaintances of twenty years previously and to collect material for "Life on the Mississippi," wherein is contained practically all of present-day opinion on river control. Although $200,000,000 to $300,000,000 has been spent and it is 46 years since the observations were made by Mr. Clemens and by Edward Atkinson, of Boston, as an appendix to the book, much the same opinion is held and by the same class of people. In those days nearly all the army engineers believed in the stabilization method; nearly all levee engineers believed in levees only; nearly all rivermen believed that the river bottom was rising; nearly all persons in the lower part of the basin believed in outlets; nearly all others who had given only superficial thought to the subject believed in reservoirs. Thus did opinions vary in 1882. Now we have auxiliary channels added and full acceptance given to the idea that stabilization methods are practicable.

Col. C. McD. Townsend once stated of these works that their effect was so promising it is to be regretted that they had not been maintained and the experiment continued. Col. J. R. Slattery, now deputy chief engineer, New York Board of Transportation, after looking over Mr. Williams' article, stated it as his impression that the works were abandoned because it was more economical to maintain channels by dredging than by permanent works. Spur dike and training walls accomplish some improvement in navigable channels but rarely accomplish the entire result, hence only reduce the amount of dredging, but, Colonel Slattery says, insufficient funds usually prevented putting the dikes as close as most engineers thought essential. —EDITOR.

TWO sections of the Mississippi River, where obstructing bars had previously hindered navigation during low-water periods, were selected to be improved by an initial appropriation of $1,000,000 made by Congress in 1881. One of these two stretches of river was Plum Point Reach. Old steamboat men aver that this reach at one time extended from Hale's Point, Tenn., to the vicinity of Osceola, Ark., a distance now, by river, of about 32 miles, but it must have been much shorter then, as the river was straighter.

Since the lower part of this reach was the most troublesome, it was improved first. The part thus selected for experiment extended from the bight of O'Donnell's Bend to the foot of Bullerton Towhead—a distance, as the airplane flies, of 11 miles; in midstream 15 miles; or, as many a steamer has been compelled to go during low water, 20 miles.

The method of improvement, as first adopted, was by contraction and revetment—that is, to shut off the "chutes" and minor openings between sandbars, thereby forcing the water into one main channel in order to induce scour. At the same time the concave banks were protected by revetment.

It was with a part of the $1,000,000 fund that the village and fleet (which Mark Twain noted as being at Plum Point) were maintained, while the banks, towheads and bars were being impregnated with Uncle Mumford's "pegs."

In detail the works of improvement were somewhat as follows: Rows of cypress or other piles were driven and braced, some across the low places between the bars, other rows projecting from the shores, usually at an acute downstream angle. Woven brush mattresses were ofttimes placed on the bottom where piles were to be driven. Mattresses were sunk along the concave banks to the low-water line. From this line to the top the bank was sloped by hydraulic grading and covered with rock or brush mats. Across the chute of Island 30 a crib dike on a woven mattress was filled with rock.

If the cost of the levee along one bank be included, the total cost of this rectifying project, to and including 1904, amounted to twelve or fifteen millions, or approximately $1,000,000 per mile.

The reports of results are somewhat conflicting and always confusing. From the reports of the Mississippi River Commission, published during the early eighties of the last century, it would appear that the problem had been solved, for it was shown that where the prevailing depth over obstructing bars had previously been 5 or 6 ft. it was, after the contraction works were completed, 10 or 12 ft. when referred to the same level. Some eight or ten years after this report was published, river steamers, some of them government owned and operated, experienced much difficulty in finding a 6-ft. depth of water in the same vicinity, when the stage was no lower than before this work was done. It was still necessary for a long time thereafter to continue placing revetment and, later during each low-water period to dredge obstructing bars within this reach about the same as in other sectors where no improvements had been made.

It is not necessary to be guided entirely by reports, since the rock, brush, piling and sand are all there and the effects can be noted by anyone who will take the trouble to look. Therefore let us make an imaginary downstream trip over this improved part of the river.

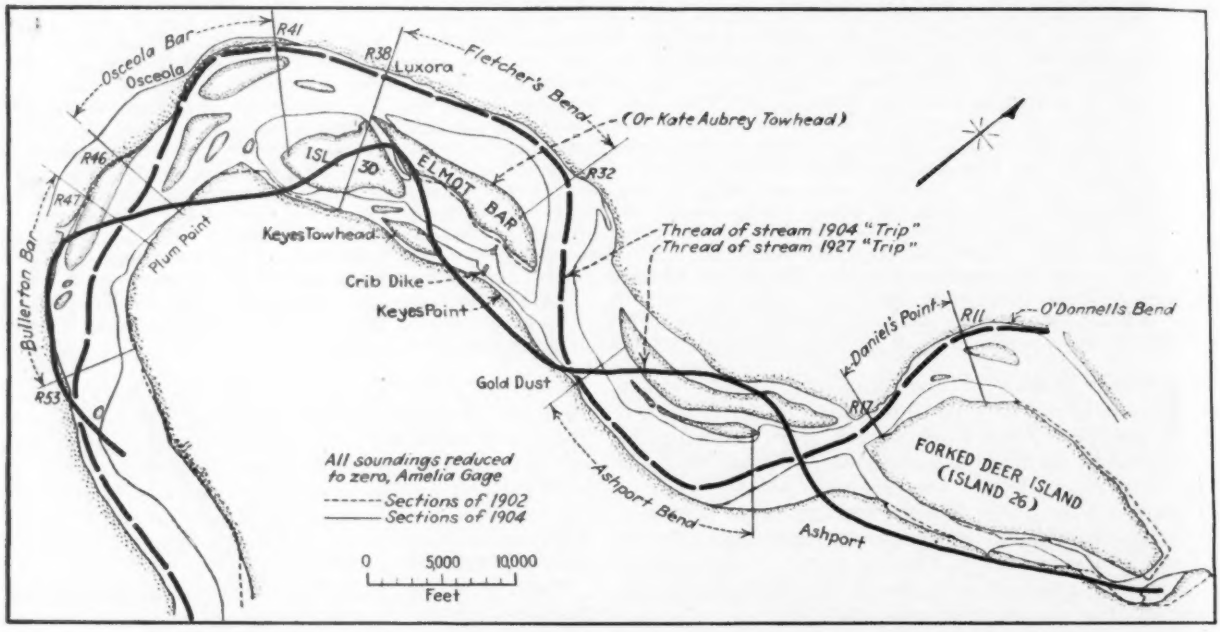
VIEWING THE RESULTS IN 1904

The year is 1904, which is about the half-way mark of time between the beginning of the improvement and now (1928). The river is low and the weather is clear.

You come down to the right of Island 26 and enter O'Donnell's Bend some distance below its head. It is noted that the upper sandbar has moved down, which is a good omen, as it will prevent the bank from caving behind the revetment. The curve of the bend is irregular. Some parts of the short line are nearly straight. At other places are points and indentations. All of the right shore, except a short stretch near the lower end, is sloping and is covered with rock or brush mattresses from the water's edge to the top of the bank. On the other side of the river the bar, jutting out from the foot of Island 26, is bluff. The low-water channel here is not wide but has a depth of from 60 to 75 ft. below zero of the local gage. Soundings have been taken for this and other years and sections have been plotted to show graphically that there is no evidence of silting or of the low-water bed of the river rising. Here we have a minimum of perimeter in proportion to section; consequently, deep in this bend, being from 30 to 50 ft. below the zero of the local gage.

The sections in this bend are wider and the slope from the bar side not so steep as in the other, but, taken as a whole, the sections show there is no pronounced tendency of the bottom to rise; however, there are several points or reefs of sand making out from the right-hand bar and extending toward the shore.

Near the foot of this bend is Gold Dust, Tenn., where there is a point covered with rock. After passing this point there is a short stretch of shore that is not revetted. Many piles were driven in this vicinity years ago, when Gold Dust was at the lower end of Ashport Bend, but the river has since got in behind these pile dikes and they are now out under a sandbar. Had you made the trip fifteen years earlier, after passing Gold Dust you would have gone nearly due north and would have entered Fletcher's Bend at its upper end, where there is now



PLUM POINT REACH IN 1904, ON WHICH IS SUPERIMPOSED THREAD OF STREAM AS OF 1927

as Edward Atkinson had prophesied in Mark Twain's book, "Life on the Mississippi," the bottom, not being of cast iron, has scoured.

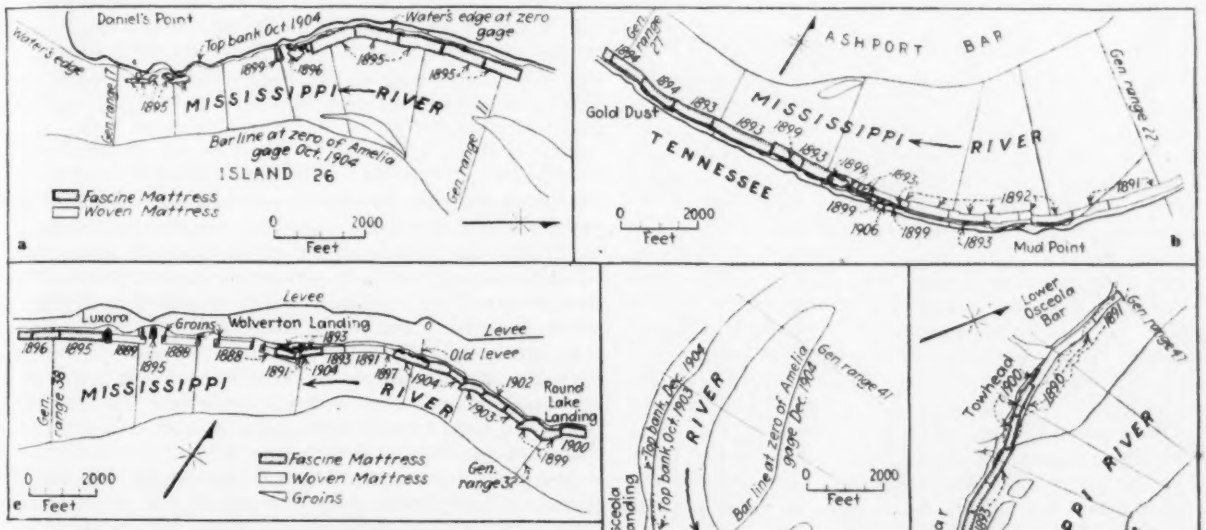
Having passed through the bend and by Daniel's Point, you are headed nearly due south in order to cross over to the river and enter Ashport Bend. Soon after passing Daniel's Point, looking to the left you observe that there is some water coming through the chute or to the left of Island 28; also that the island is caving, on the chute side, near its lower end. To the right and nearly opposite the chute of No. 26 there is a large-sized dry ditch through the lowlands making from Daniel's Point.

Again looking to the left you see a sandbar, comprising some 200 or 300 acres, in front of Ashport, Tenn. There is nothing unusual about a bar being in the head of this left-hand bend and, besides, it extends downstream far enough to cover the upper end of the revetment. This bend is somewhat longer than the upper one and more concave. The shore revetment extends its entire length but is not in as good condition as that in O'Donnell's Bend, since it is older and will need some repairs, but this is to be expected. The water is not so (1904) a flat bar covered with willows just high enough to hide a goose.

Leaving the Tennessee shore, you head in a northwesterly direction toward Arkansas. Looking to the left, while making this crossing, you see the chute of Island 30, where there is some water flowing between bars. One of these makes out from the head of Kate Aubrey Towhead (Elmot Bar) and the other from the Tennessee mainland, just above a bulge in the shore line known as Keyes Point. About ¾ mile down in this chute is a dark streak across a pool of glassy water. This streak is the dam or crib dike extending from the Tennessee shore to Kate Aubrey Towhead. It was put there to close off this chute. By closer inspection it will be seen that there is an opening in this dike through which water is flowing—not much, but some. A little farther away and to the left is Keyes Towhead and still farther down is the head of Island 30, where the waters of the chute are divided, some going to the right and others to the left of the island. After making these observations you continue on by the head of Kate Aubrey and enter Fletcher's Bend, where, as in the other two, the banks are revetted and generally stable. There is a bar covering the upper

end of the revetment and the deepest water is near the shore.

In the other two the sections show that the bends are narrower and deeper as their lower ends are approached and the shore sides of the channel are nearly vertical, but this bend is different, as there is a sandbar near the shore, in the bight of the bend a mile or so above its lower end. This bar covers the revetment along Lower Osceola Bar and the head of Bullerton Towhead; you therefore leave the shore below Osceola, Ark., and steer out into the river for a ½ or ¾ mile, then come back to near the revetted bank extending nearly the entire length of Bullerton Towhead. At the lower end of this towhead is Sans Souci—though you never would suspect it from the general appearance of things—where the Reach officially ends, in so far as protection works are now concerned. There is some piling farther downstream, but this is now so far out in Tennessee as to be difficult to locate. At the lower end of the bend just traversed there is some change of section, but the tendency evidently is to narrow and deepen.



LOCATION OF REVETMENT, MATTRESSES AND GROINS WITH DATE OF LAYING
(a) Daniels Point; (b) Ashport Bend; (c) Fletchers Bend; (d) Osceola Bars; (e) Bullerton Bar.

This ends the imaginary trip and, actual conditions having been noted, some definite conclusions may be predicated on the observation. It is evident that the stabilization of the banks has prevented silting. For several years there has been no great change in the shape or area of low-water section. There are no indications of the river's bottom being elevated. Therefore Mr. Atkinson, backed by science, wins the first decision—on points. But Uncle Mumford, Mark Twain's steamboat mate of 30 years' experience and observation, is not yet "hors de combat," or at least the river with which he was so well acquainted is not.

The first half of the period of improvement having passed, we now enter the second. There are no clear lines of demarcation between the two intervals of time, as these have been arbitrarily divided merely for convenience.

The Second Period

After 1904 appropriations continued to be made about the same as before, until such time as we entered the "progressive era," when there was much excitement about the "14 ft. through the valley foolishness." Then came the project or proposition of utilizing the equipment and organization that had recently completed the digging of the Panama Canal to excavate an auxiliary channel, 600 miles long, to be used by the Mississippi River if it felt so disposed. This later project was given wide publicity and much serious consideration, not so much because it possessed inherent merit but because its sponsor happened to be the President of the United States. These agitations produced beneficial results. Larger appropriations were obtained.

The work of rectifying the river's regimen and building levees continued. When everyone believed the river had been tamed and rendered harmless, there came the unprecedented floods of 1912 and 1913. These were epochmaking because thenceforth "high waters" ceased and "floods" prevailed. Prior to 1913 and to a limited extent since, if a flood was mentioned it was always understood to be the one in which Noah, the Ark, the dove and the olive branch gained fame. This change in mode of thought necessitated a change in method of obtaining appropriations, for whereas the Mississippi River had formerly been dependent on river and harbor acts and sundry civil bills, it was thereafter combined with the Sacramento River and became a distinct flood-control project.

There were several good and valid reasons for this change. Aspersions had been cast upon the character of the river and harbor acts by scandalmongers and others, who claimed these to be "logrolling" affairs. Future appropriations were more definitely assured if the efforts of the various and numerous associations throughout the valley could be concentrated at one point of attack. In addition, the navigation problem or the desire and need to facilitate commerce and the postal service by improv-

ing inland waterways had ceased to exist, because there were but few boats and not enough traffic to support these few.

Though river traffic was decreasing, appropriations were not. Under the provisions of the flood-control act, $5,000,000 or $6,000,000 a year was supplied for several years, then the amount was raised to $10,000,000 per annum, and this year that amount is trebled, with a total in view of $325,000,000 for a completed project.

The construction and maintenance of the levee system assumed paramount importance after these increased appropriations became available. There being no levees near the river along the Plum Point Reach except at a few places where the banks were already protected, the major part of the work was done elsewhere. No further effort was made to contract the channel in this vicinity. Even repairs to revetment in this reach were discontinued about 1919, and the completed job was turned over to the river for its use.

A 1927 River Trip

The year is 1927, the end of the last half of the 47-year period of river improvement. As before, the river is at a low stage, and you start at the head of Island 26 and go downstream. But instead of going to the right of the island you go to the left, because there is a dry sandbar on the other side. Passing the head of the island, you enter a left bend. At the foot of this bend you pass through or over a part of the site of Ashport, Tenn. You are now headed west and cross the 1904 channel at nearly right angles. Looking to the right it appears as if the willows extend from the foot of Island 26 to the Arkansas shore. There is a low place and a small opening in these willows. This depression marks the location of the former deep and narrow channel between Daniel's Point and Island 26 that had "less perimeter in proportion to section," but evidently there was a slight mistake made somewhere, for it did not continue to scour but filled. There may be enough water now in this former channel to float a skiff, but you are too far away to tell.

Continuing, you enter a right-hand bend that is directly opposite one you navigated before. To your left the tops of high trees, a mile or two away, form a nearly straight line against the sky; a little nearer to you is another lower and less clearly marked line, made by the tops of willows. The high trees are along the revetted shore of Ashport Bend, that was to stabilize the river. The low willows are where the channel was 23 years ago. To the right you notice a large ditch through which some water is flowing. Through this motorboats can pass from Ashport, Tenn., to Luxora, Ark., during ordinary river stages. This bend is not very concave, nor is it long. Leaving it, you pass Gold Dust, Tenn., about the same as before, but instead of turning off in a northwesterly direction to go over to Arkansas you go southwest into a left bend, where Keyes Point was formerly. You look for the crib dike that was to close off the chute of Island 30, but none of it is in sight. Possibly a part of it retains its former location, but it is now well covered with sand and willows. You are well over in Lauderdale County, some distance beyond the Tennessee end of the dike.

You do not pass across the head of Kate Aubrey Towhead as before, because it, with its bar and willows, extends along the right side of the channel to the chute or ditch you saw some 2 or 3 miles upstream.

Leaving this short left bend, over what was a few years ago taxable farmlands, you cross over to near the foot of Kate Aubrey Towhead, then circle to the left across the site of a 200- or 300-acre farm on Island 30. If the day is clear and you know where to look, you can see the water tanks at Luxora and Osceola, Ark. After passing over what was formerly Island 30 you are headed toward a short left-hand bend, made into what was formerly Plum Point. But instead of passing a mile or more to the west of where the Plum Point store, cotton gin and steamboat landing formerly were situated you now pass half a mile or more to the east of that location. The river has removed the plantation, and several years before this trip a steamboat sank in 40 or 50 ft. of water near where the cotton gin stood, but both the boat and the gin site are now covered with sand on which willows are growing. After passing what is now termed Plum Point, though in reality a bar made below that point, you again cross the river and enter a right-hand bend that might appropriately be called Fletcher's Bend, but you are now some 6 or 7 miles below the place where you entered that bend 23 years ago. Now, following the caving bank of the right-hand shore, you pass the lower end of Bullerton Towhead and end the second imaginary trip.

The Works Have Disappeared

During this last trip down no mention was made of revetments or works of contraction, for the simple reason that there was none in sight, except near the lower end of Kate Aubrey and well out on the bank the tops of a few old piles; but one must be a close observer to distinguish these from the rotten tree stumps by which they are surrounded. There are also a few piles that were driven near the southern shore of Plum Point and were for a long time covered with sand and trees but are now being dug out by the river after it had removed the mainland and entered into the bar below.

Much revetment is still intact, but during low-water periods it would be necessary to organize an exploration party and do much excavating to locate the greater part of the $12,000,000 or $15,000,000 worth of bank protection and channel contraction work done within this Reach.

As far as this change of channel from the stabilized to the unstabilized condition has affected navigation, it has been beneficial. Before the change and while it was being made there were always obstructing bars to be found at several places, whereas during recent years there has been only one point (near Ashport) where dredging was necessary in order to maintain a channel of project dimensions. From this it appears that Uncle Mumford was correct in his surmise about this not being "the kind of river that you can boss around and make stay where you put it." Therefore he wins the second decision with a knockout blow.

To sum up the experiment of Plum Point Reach, it may be permissible to quote from the findings of the committee of Engineering Council, as published in *Engineering News-Record*, Feb. 9, 1928, and state that apparently the principles of stabilization projects, just as recommendations of flood protection, "do not rest on a sufficiently adequate knowledge of the underlying facts to make them dependable."

Concrete-Placing Equipment in Spain

The mast type of concrete-placing equipment has been employed for the first time in Spain in the erection of the new railway station at Barcelona, according to reports received by the U. S. Department of Commerce.

Combating Ice and Low Temperature at Hydro Plants in Norway

Methods of Combating Ice Troubles at Spillways and Intake Racks, Together With Repair of Roller Gate Sill at Raanaasfos

By Oren Reed

Assistant Designing Engineer,
San Joaquin Light & Power Corporation, Fresno, Calif.

ICE TROUBLES were very serious at the earlier Norwegian hydro plants, but the causes of these difficulties have been closely studied and methods have been adopted which largely obviate operating troubles from ice at the modern plants. Supplementing an article on design and operation of Norwegian sector and roller gates, published in *Engineering News-Record*, Sept. 6, 1928, p. 358, the writer sets forth in the following the results of observations of Norwegian practice in combating ice troubles at spillways and intake racks.

The natural state of the rivers of southeastern Norway, with many rapids and falls, was very favorable to the formation of needle ice, which was difficult to handle. The earlier plants, as Kykkelsrud and Hafslund, had only small forebays but diverted the flow through long headraces to the power house. The velocity in the headrace was high, and block and needle ice was carried to the intake racks, where they accumulated rapidly and sometimes caused complete shutdown of the plant. At the more modern plants a series of minor falls and rapids are combined into one head by a dam. This forebay pond is soon covered with ice in the autumn and flow for the plant is drawn from beneath the ice cover.

The ice cover on the forebay is an effective means of preventing drift ice from reaching the intake racks. Surface ice is broken up into drift ice by variations in the river level. Ice chutes were provided at the forebays of the older plants to take care of block ice. A surface current is created along the racks when the control gate is open and the ice is easily removed. Needle ice tends to rise and stick to the ice cover of a large forebay and does no harm. When the forebay is small, the velocity of the water is comparatively high and the needle ice is carried to the racks. When the ice needles strike the bars of the racks, they stick to them, accumulating rapidly until the intake is choked up entirely. The rack bars are thus subjected to a severe strain.

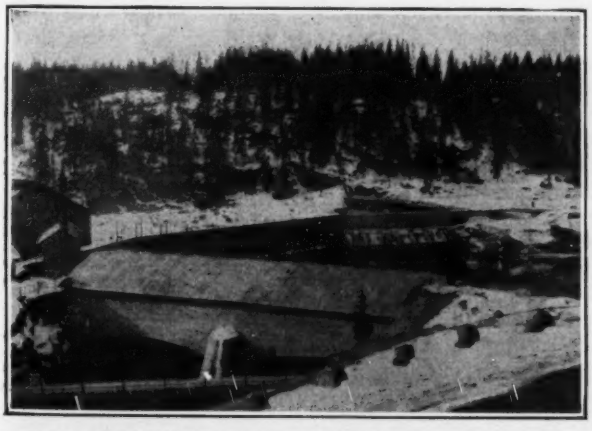


FIG. 1—DAM AND INTAKE AT KYKKELSRUD, NORWAY
Forebay pond is shallow and the approach velocity is comparatively high, causing block and needle ice to be carried into the headrace, at left. Siphon spillways, in center, having a capacity of 8,800 sec.-ft., serve for pond regulation.

FIG. 2—NEEDLE DAM AT KYKKELSRUD
Needles are difficult to keep tight and workmen must maintain an open lane in ice in front of dam.

During the first years of operation at Kykkelsrud hand rakes or scrapers were used to clear the intake. The rack bars are about 28 ft. long and it was nearly impossible to keep them clear. During the winter season 100 to 120 men were employed in this way. In 1913 electrical heating of the rack bars was first tried. The bars are in groups of four and the groups are in series. The series connection is made by a piece of channel iron, welded to the end of the bars. The bars are fastened to an oak framework, which serves as insulation. About 300 amp. of 50-cycle alternating current is required per bar. Power consumption at Kykkelsrud is about 0.2 kw. per second-foot of flow. Electrical heating of the racks has been very successful and only one man is now required to take care of the forebay. This system is also installed at Vamma, Raanaasfos, Lerfos and Hafslund in Norway, and Trollhatten in Sweden.

Heating of the racks with steam has been tried but has not been very successful. In such installations, the racks are made hollow and contain steam pipes. Mechanical rakes were also tried without success.

At Vamma and Solbergfos the generators are totally inclosed and the heated air is led through large ducts to the dam and forebay. The outlet is above the normal water surface and the current of air can be directed to the water near the racks. Except in very severe weather the ice is melted to a distance of 15 to 25 ft. from the racks. Electrical heating of the rack bars has not been necessary at Vamma, and at Solbergfos entire reliance is placed on the heated exhaust air to prevent ice trouble at the intake. It has not been necessary to use the electrical heating system at Raanaasfos. At this plant there is a set of coarse screens in front of the usual intake racks. The spacing of the coarse screens is 3.2 in. In winter the upper half of the intake rack is removed and small pieces of ice and drift are carried through the turbines without harm. There has been no clogging at the coarse racks.

Serious trouble has been experienced at needle dams from ice. If ice is allowed to freeze to the needles, the needles will be lifted over the sill when the pond level rises and the diversion will be temporarily lost. Constant attention from the operators is required to prevent ice formation on the needles. The curved upstream faces of sector and roller gates prevent the attachment of surface ice to these gates.

Trouble at Expansion Joints—Due to the large daily and seasonal variation in temperature, contraction joints in dams are closely spaced. At Vamma dam the contraction joints are 32.8 ft. apart. The spacing at Raanaasfos dam is 32.8 to 49.2 ft. between the contraction joints. An ingenious and interesting repair was made at the seal beam of the roller gate at Raanaasfos in 1926. About two years after the dam was placed in service considerable leakage developed at the I-beam on the spillway crest. It was found that the leakage occurred through the concrete around the bearing beam at two contraction joints and at one break at the splice joint along the I-beam.

The breaks were about 12 in. wide. They started (as shown in the sketch) at one side of the seal beam, continued under this and up on the other side. The concrete was partly washed away and that remaining in the bottom of the break was greatly damaged. The gate seat should have been broken at the contraction joints and end clearance between sections of the I-beam should have been greater, as the spillway of the dam has a full south exposure and the dam as well as the gate is subjected to great variations in temperature.

When it was decided to make repairs, a cheap method had to be adopted. A cofferdam would have been too costly for the small job and require too long to build.

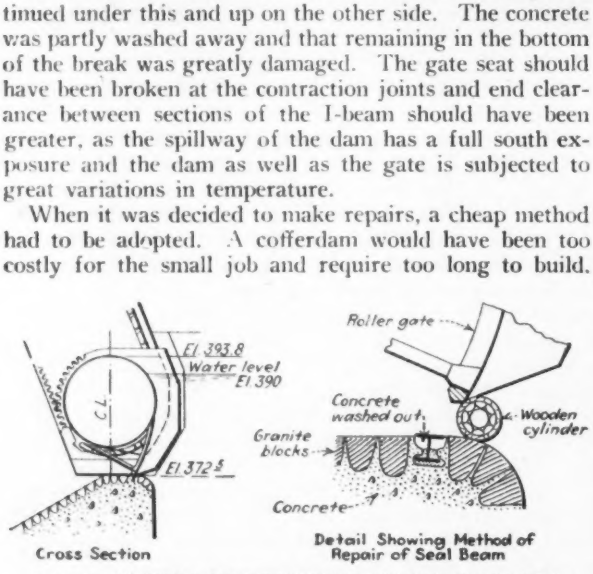


FIG. 3—METHOD OF REPAIRING ROLLER GATE SILL AT RAANAASFOS, NORWAY

After some study it was decided to use wooden cylinders placed in front of the roller gate in such a way that after the roller was lifted somewhat, the cylinders would be forced against the apron of the roller and the crest of the dam by the water pressure. The wooden cylinders, as constructed, had an outside diameter of 21.6 in. and a length of about 16.4 ft. They were covered with 2x5-in. planks and stiffened internally by open ribs made of 2-in. planks. The longitudinal planks were fastened to the cross-ribs by ordinary 6-in. nails and the ends of the cylinders were made tight.

When the repair work was started, the cylinders were brought out in front of the roller gate on a float and filled with enough sand to sink them, so that they could be easily placed in position by a diver. They were placed end to end with about 0.2 in. clearance. The roller gate is provided on both ends with seal plates which could not be tightened by the cylinders, and wooden wedges were constructed for this purpose. These were made up of three pieces held together by a bolt. When the wedges were in place, the downstream parts could be detached by loosening the bolt from the lower side, thereby leaving the seal beam entirely free.

When everything was in place, the roller gate was lifted about 15.7 in. and the cylinders and wedges settled into position. There was some leakage at first, but within a short time this had decreased so that the repair could be carried out. The breaks were thoroughly examined and it was found that the concrete outside of the cracks was not damaged. After the breaks were cleaned of all damaged concrete they were filled with 1 : 1 mortar. The shrinkage crack along the I-beam was grouted under a pressure of about 10 lb. per sq.in.

After the repair had been made and the new concrete had set eight days, the roller was lifted and the cylinders and wedges were forced from under the gate by the water. The whole work of repair, including the making of the cylinders and wedges, was inexpensive and required three days.

Unusual Design in New Theodolite

Geodetic Survey Instrument for Precision Work Embodies Many New Ideas—Field Test Proves Satisfactory

By Douglas L. Parkhurst
Chief, Instrument Division, U. S. Coast and Geodetic Survey

THE theodolite is purely an angle-measuring instrument. In theory it is quite simple, consisting of a graduated circle mounted on a suitable leveling head which may be set rigidly with respect to the earth. A telescope fitted with cross-wires is revolved upon a central axis with reference to this circle, and the angle between two points on which the telescope may be trained is measured by means of suitable microscopes attached to the telescope support. To construct an instrument that will accomplish this regular measurement with the refinement necessary for precise work is much more of a problem than would appear from the foregoing description. In the first place, fits between moving parts must be exceedingly close. The circle must be very accurately divided, with no unevenness in spacing of the dividing lines, the line of graduations must be truly circular, and the graduations themselves must be concentric with the axis of rotation of the telescope. There must be no play between the axis and its socket, there must be no changes in dimensions due to variations in temperature which are not compensated for and there must be no warping of the materials due to aging or other reasons. These are only some of the major problems involved in the design of such an instrument.

The U. S. Coast and Geodetic Survey has experienced great difficulty in procuring satisfactory theodolites and has, accordingly, designed and built an instrument that possesses a number of decided advantages. In this instrument the three-armed leveling head is made of a stiff aluminum composition, with U-shaped cross-sections to give a maximum of rigidity with a minimum of weight. The leveling screws are of steel, with threads smoothly and accurately cut, and are carefully fitted into their respective threaded holes in the leveling head, the latter being provided with clamping screws so that, after leveling, the head may be locked in position.

The bearing for the vertical axis upon which the telescope revolves is made of a homogeneous cast iron which is tightly threaded into the aluminum head. As an added precaution, this part is made slightly oversize, and, when assembling, the head is heated, the socket screwed tightly into place and the aluminum allowed to shrink onto it.

The axis of the new theodolite is designed according to an entirely new principle. It is about 5 in. in length,

the bearing being in the form of two truncated cones of decidedly different angles, the cones, extended, meeting at a common apex, this apex being very nearly at the actual lower end of the axis. The angles used were 15 deg. and 60 deg. respectively. With this design differences in temperature coefficients of axis and socket are of no moment, as lateral and longitudinal expansion are always proportional and the fit is maintained regardless of how the temperature may vary, the only result being that the telescope may be elevated or lowered slightly. This part is a forging of high-grade tool steel and is unhardened, as it was felt that the hardening process might set up strains in the material which would ultimately release themselves, resulting in warping.

The standard is of hard cast bronze. The telescope rests on wye-shaped bearings at the top, having stainless steel inserts at the points where there is contact. One side is slotted and is provided with two adjusting screws so that the surfaces of the wye may be raised slightly by squeezing them together, for adjustment of the axis of the telescope for horizontality. The micrometer microscopes by means of which the circle is read, are the most delicate part of the whole instrument. The microscope consists of an objective and eyepiece which magnifies the image of the graduations many times. The aperture of the objective is such that one full degree on the circle may be observed.

The micrometer slide is actuated by a fine pitched screw working against two light springs. In the instrument being described, the micrometer drum is divided into 120 parts, and 2½ turns equal five minutes. A most

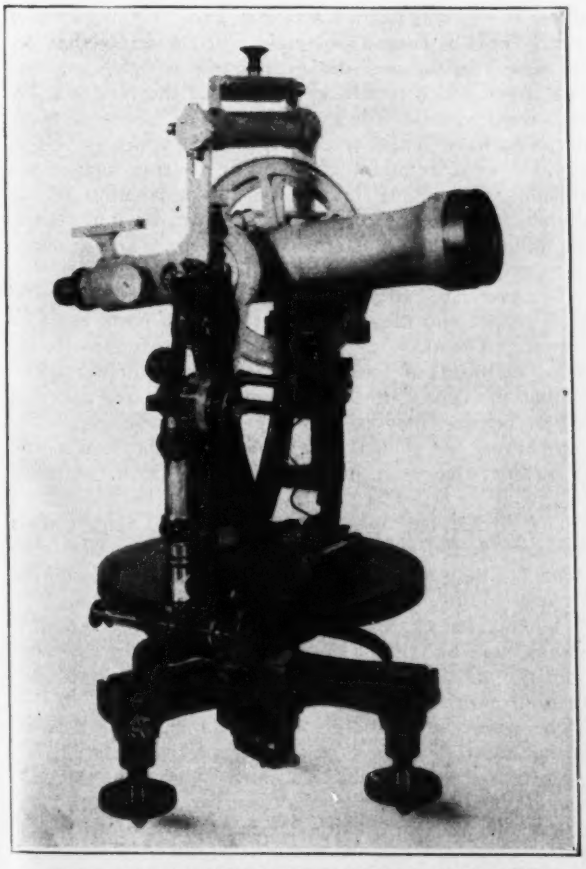


FIG. 1—NEW THEODOLITE BUILT BY COAST AND GEODETIC SURVEY EXPERTS

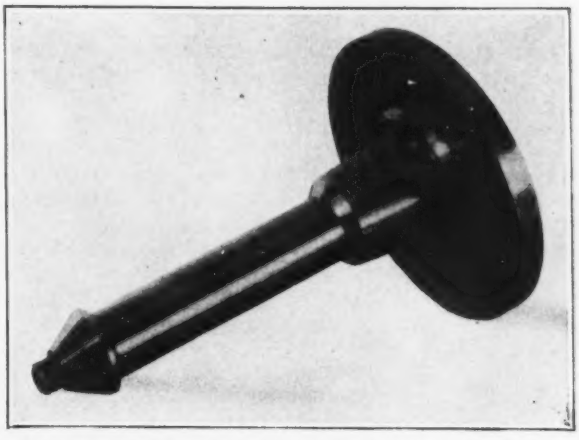


FIG. 2—THE VERTICAL AXIS BEARING IS OF TWO CONICAL SEGMENTS WITH THE SAME APEX

important feature of these micrometer boxes is that there shall be no lateral motion when the traversing screw is rotating, other than that due to the advance of the thread; consequently, errors in lead of the screw must be carefully guarded against. Where the thrust is taken up by a screw ending in a point working against an anvil, as in the type shown in the illustration, this point must be concentric with the axis of rotation. In designs where there is a collar bearing against a plate, the thrust surface of this collar and its corresponding bearing on the box proper must be a plane normal to the axis of rotation, and provision must be made to prevent the introduction of dirt.

To facilitate the reading of the micrometer a very fine comb is located in the box at the focal plane, the teeth of the comb being spaced one minute apart as measured on the drum. At the center of the comb a deeper slot is used as a zero point and adjustment is provided so that this may be moved endways in the box to insure location of the two zeros 180 deg. apart. As the drums of the micrometer microscopes are to be read at night, it is necessary to provide some means of illumination for them. It has been the practice in the past to make these drums of metal or white celluloid and to illuminate them with a flashlight when a reading is to be taken. As the intensity of the flashlight illumination is very much greater than that of the signal as seen through the telescope, it has an annoying blinding effect upon the observer. In this new instrument the micrometer drums are made of a thin ring of glass, carefully ground circular, the lines and figures being etched upon the exterior surface. The reference line is also on glass, and its underside, together with that of the graduation ring, is lightly frosted. A small electric bulb is mounted so that its rays illuminate the interior of the ring when a key is pressed, causing the graduations to stand out boldly. The brilliancy of the bulb may be regulated by a rheostat.

The microscopes are mounted about 3 deg. from the vertical, to facilitate illumination of the graduated surface. The microscope eyepiece is fitted with a prism so that observation may be made at about 45 deg. from the vertical. The microscopes are mounted in an aluminum casting attached to the standard by a stout hinge bearing at the top, with a lug fitting tightly into a corresponding slot in the standard to prevent sideways motion. The lower end carries a ¼-in. threaded stud, which, passing through a hole in the standard, allows for radial adjustment by means of two counteracting nuts. This part is

similar to wye level design. The two microscopes are mounted as nearly 180 deg. apart as possible, the final adjustment being made by the setting of the zero point within the micrometer itself.

The telescope is about 18 in. long, has an objective of 2½ in. clear aperture and is fitted with a 6-in. vertical circle read by verniers to ten seconds. It is of the inverted interval focusing type, internal focusing being considered by many to be the best for such surveying instruments, as the design facilitates balancing and the telescope may be practically hermetically sealed.

The optical qualities of the telescope must be high grade, and a resolution of 2½ to 3 seconds is specified. This means that an object so small that it subtends an arc of only 2½ to 3 seconds must be clearly visible. The telescope is fitted with an eyepiece of about 45 magnifying power.

As precision surveying is done at night, to cut down

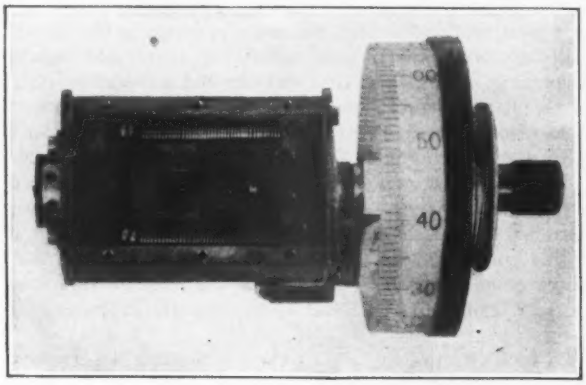


FIG. 3—DETAIL VIEW OF MICROMETER

the effects of horizontal refraction due to heated air currents, it is necessary to provide illumination for the cross-wires. This is done by drilling a small hole lengthwise of one of the trunnions of the telescope and placing a shielded electric bulb so that it will shine through this hole against a small 45 deg. prism or mirror located at the junction of the axes of trunnion and telescope. Intensity of the light may be controlled by a small rheostat.

The work being done in nearly total darkness and the field of view of such a telescope being restricted, it is convenient to have some sort of external pointing device which will make it easier to train the telescope upon the signal. This consists of a half segment of a lens mounted on top of the telescope at the eyepiece end and focusing a few inches away along the barrel upon a small frosted glass plate, blackened with the exception of a small triangle. This plate is illuminated by a small bulb shielded so that no light may come to the observer's eye except through the half lens. The triangle then appears as a bright spot and when properly adjusted the observer may look over the top of the sighting device and see both the signal light and the illuminated triangle at the same time. When the triangle is brought in conjunction with the signal light, the signal will appear in the field of view of the telescope and final adjustment is easily made.

The assembly of telescope, standard and microscopes is commonly referred to as the alidade. This assembly is rotated upon the vertical axis as a unit, and when a pointing is to be made, may be clamped and a slow motion tangent screw used for fine adjustment. Improper design of this clamp and slow motion screw are a prolific source of trouble. Both clamp and slow motion screw of the new theodolite are departures from the customary. The clamp is in two parts which fit around a carefully machined surface directly beneath the bearing of the graduated circle. These two parts, when tightly fastened together, must turn freely but must not be loose, one side extending to and beyond the cover of the circle. This end is forked, one side carrying the slow motion tangent screw and the other a counteracting spring and plunger. The slow motion screw acts against a lug fastened to the cover and projecting into the fork. The other half of the clamp extends in the opposite direction and is merely a counterweight. Clamping is effected by means of a rectangular block sliding radially in a carefully fitted recess in the clamp body, its inner surface being an arc of the same radius as the bearing. A long thumbscrew extending beyond the fork in a radial direction has a pointed end which presses against the block and, forcing it against the bearing, locks the clamp. The design is such that upon releasing the pressure of this thumbscrew, the block is withdrawn from the seat so that there can be no dragging. In practice it has been found that the weight of the clamp introduces an appreciable amount of friction upon rotation of the alidade, and in this instrument a light thrust ball bearing has been introduced at this point to prevent this.

In customary tangent screw design, the screw, actuated by a thumb wheel, presses against a lug on the alidade and works against a spring and plunger. If the end of this screw is pointed or rounded and the contact point is not concentric with the axis of rotation, an irregular and lifting motion is imparted to the alidade, which is troublesome when making fine adjustments, and furthermore this screw is exposed to dust and dirt, resulting in excessive wear. It is of course important that the screw shall not be loose. In the new design a thumb wheel is attached to a sleeve which rotates in one arm of the fork, suitably restrained against lateral motion. The sleeve is bored out and threaded and actuates a plunger which is held by a pin against rotation, the plunger bearing against the alidade lug, moving in and out upon rotation of the thumb wheel. No eccentric motion can be imparted to the alidade, as the plunger does not turn. The threaded parts are entirely inclosed away from dust and dirt.

The graduated circle is made up of two parts, the circle plate proper and the central bearing, both parts being of bronze. The plate is adjustable with reference to its center by means of four counteracting fine pitched screws so that the center of the circle of graduations and that of the bearing may be brought into coincidence. The graduations are applied by a dividing machine on a ring of sterling silver 9 in. in diameter, $\frac{1}{16}$ in. thick and about $\frac{3}{8}$ in. wide.

The circle plate is mounted on two 45 deg. conical bearings on the exterior of the cast-iron vertical axis socket. These bearing surfaces are 1¼ in. apart, and the circle is held in place by gravity and by flat springs. The circle may be turned to any position by hand and is held in place by friction only. As it is entirely separated from the alidade, no turning movement is applied upon rotation of the latter.

The complete theodolite weighs 33 lb. It was used during the 1927 season on an arc of triangulation between Harpers Ferry, W. Va., and Pittsburgh, Pa., and gave excellent results, the average error of closure of the 64 triangles measured with it being 0.81 second of arc. As it is axiomatic that the included angles of any triangle total 180 deg., or 648,000 seconds, the average error of closure was then one part in 800,000.

FIG. 1—COMPLETED NEW SPAN ON PENNSYLVANIA RAILROAD'S MONONGAHELA RIVER BRIDGE
Temporary sidetrack in foreground on girders. Stiff-leg derrick on top chords used to dismantle old span.

Replacing a Railway Span at Congested Site

With a River at One End, a High Bluff at the Other and a Railway Yard Beneath, Renewal Was Made Without Interrupting Pennsylvania Railroad Traffic in and Out of Pittsburgh

AN UNUSUALLY difficult piece of railway bridge work was encountered in renewing the 183-ft. span in the Monongahela River bridge on the Pennsylvania Railroad Company's Panhandle Division at Pittsburgh. This span carried the Pennsylvania over the Baltimore & Ohio passenger yard, and therefore during the renewal work very heavy railway traffic had to be maintained under the span as well as over it. The problem was further complicated by the fact that no storage space was available for the construction materials at either end of the bridge. The south end of the span was over the river, with street crossings and a tunnel through a near-by high bluff on the north end. The only place available for storage of erection materials and the new steel was a yard on the south side of the river about a mile from the site of the work. As new steel or erection materials were needed they were transferred, by work train between regular train schedules, across the river and placed on a temporary sidetrack erected alongside the main tracks.

In brief, the job was accomplished by erecting the new span on falsework spanning the B. & O. tracks and alongside the old span, and then rolling the old span downstream at the same time that the new span was rolled into permanent position. This necessitated (1) cutting down the north masonry pier No. 2 (the south pier had been cut down when the new river crossing spans were erected in 1903), (2) supporting the old truss span during masonry alterations and the insertion of the roller nests, (3) erecting falsework extensions upstream and downstream from the old piers for the support of the roller nests to be used later for shifting the old and new spans, (4) erecting the main falsework to carry the new span during erection, (5) erecting the new span on falsework, (6) rolling both spans downstream simultaneously until the new truss span was in permanent position on the old piers, (7) dismantling the old span with stiff-leg derricks placed on the top chord of the downstream new truss and (8) removing the falsework.

Masonry Alterations—The masonry alterations on the north pier were required by an increase in distance from base of rail to bridge seat for the new span. This lowering of the bridge seat made it necessary also to construct a new concrete wall on the pier for the support of the ends of the approach girders.

The first step in the work was the placing of jacking bents and jacking rigs as shown in Fig. 3. A section

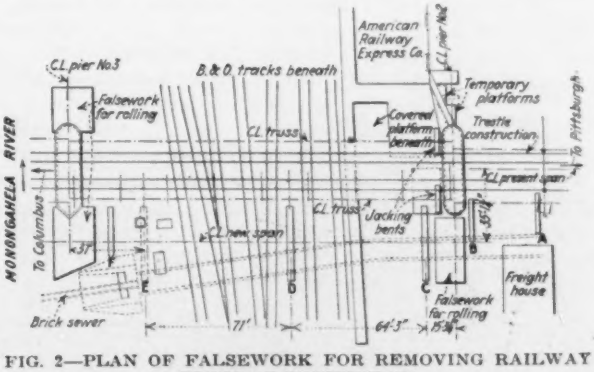


FIG. 2—PLAN OF FALSEWORK FOR REMOVING RAILWAY TRUSS AT PITTSBURGH
Note cramped location of work, with Monongahela River at one end, trestle at other end and railway tracks beneath. Falsework extensions to piers used for rolling old truss out of position and new truss into position. Other falsework used to support sidetrack and new truss during erection.

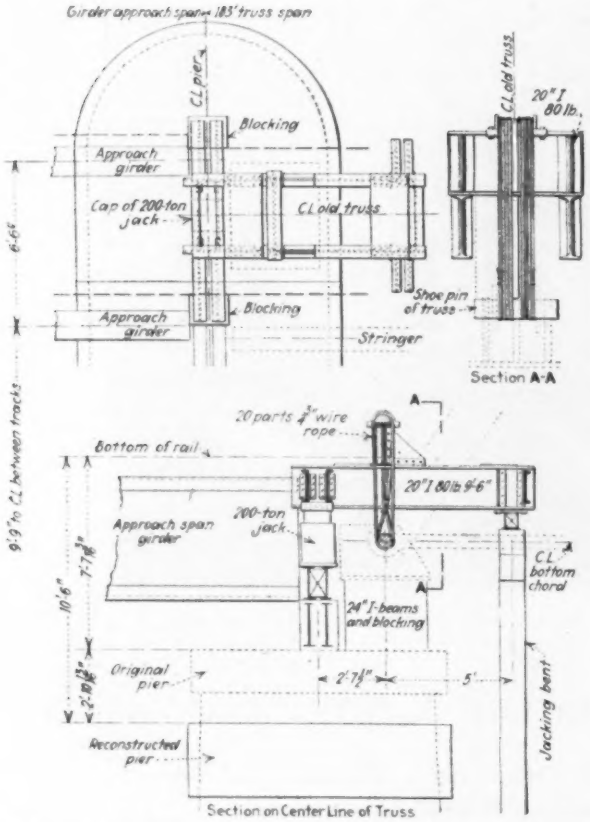


FIG. 3—JACKING RIGS USED ON NORTH PIER TO PLACE OLD TRUSS ON ROLLERS
South pier jacking arrangement similar.

about 1½ ft. long had to be burned from the ends of the approach girders to permit the placing of the jacking rig on the north pier and further to give sufficient clearance for moving the new span into position. The rig consisted of a 200-ton jack whose force was applied to the truss pin through a lever beam and ten turns of ¾-in. wire rope.

Between trains the shoes of the old span were jacked up one at a time, the old pedestals removed and two groups of 24-in. I-beams 8½ ft. long inserted on bearings resting on the masonry (Fig. 4).

With this accomplished, the old masonry was removed between lines *AA* and *BB* (Fig. 4) at both ends of the pier and new grillages placed to receive the new span. The first grillage consisted of 18-in. I-beams 5 ft. 2 in. long, on top of which were placed 1-in. plate fillers and an additional grillage of 15-in. I-beams with cover plate 5 ft. 2 in. long. This cover plate was at the exact elevation of the top of the new coping.

Before further jacking of the old span, the two groups of 24-in. I-beams 8½ ft. long were attached to the shoes so that they would lift with them. Then between trains these shoes were jacked up one at a time and the bearings under the 24-in. I-beams removed and replaced by wood blocking. This, in conjunction with the steel grillages, carried the truss loads to the pier. Then after blocking the east approach girder on a temporary falsework bent the masonry outside of lines *BB* was removed at both ends of the pier and replaced outside of the construction joints by the new concrete coping.

On this new concrete, blocking was placed to carry two 20-in. I-beams 28 ft. long for the support of the end stringers in the old span, and another group of three 20-in. I-beams 28 ft. long for support of the ends of the girders of the approach span. Blocking was placed between the old masonry and the bottoms of these two

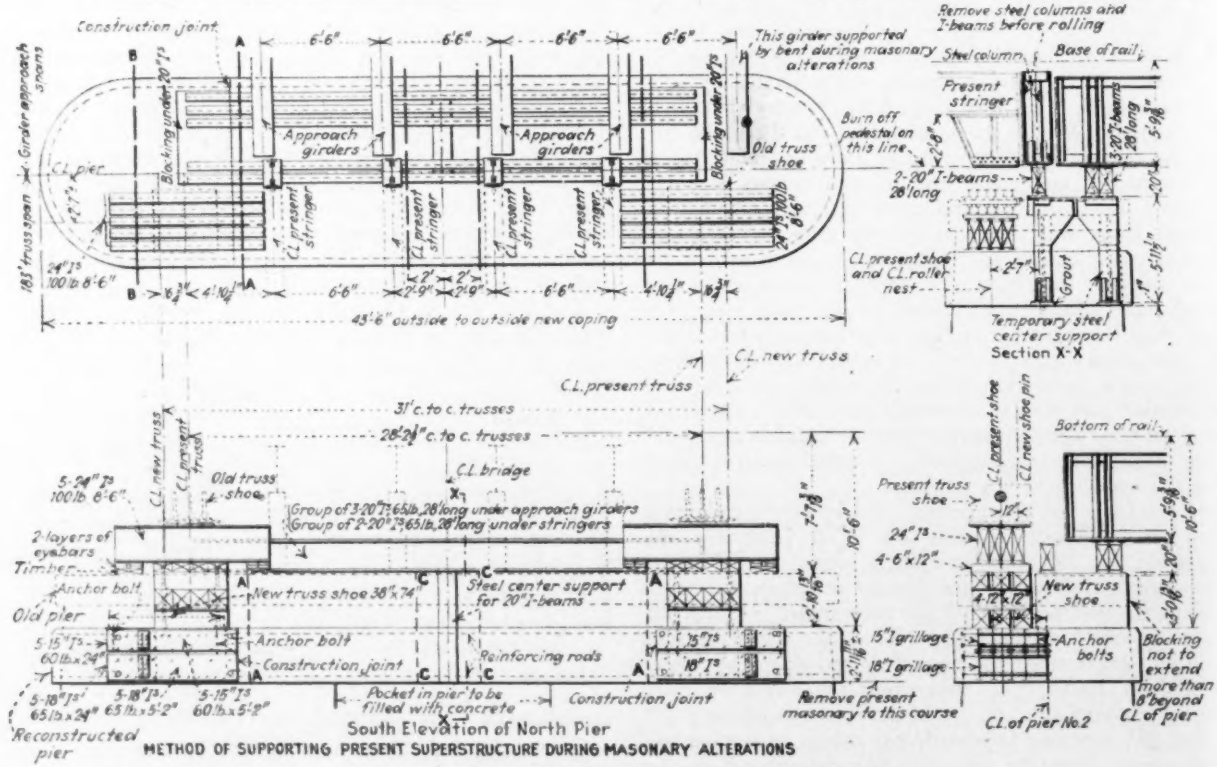


FIG. 4—MASONRY ALTERATIONS AT NORTH PIER
This pier had to be cut down to take the deeper new truss. Removing the old masonry, transferring the old truss to rollers and placing new grillages and concrete for the new truss required an unusual co-ordination of operations.

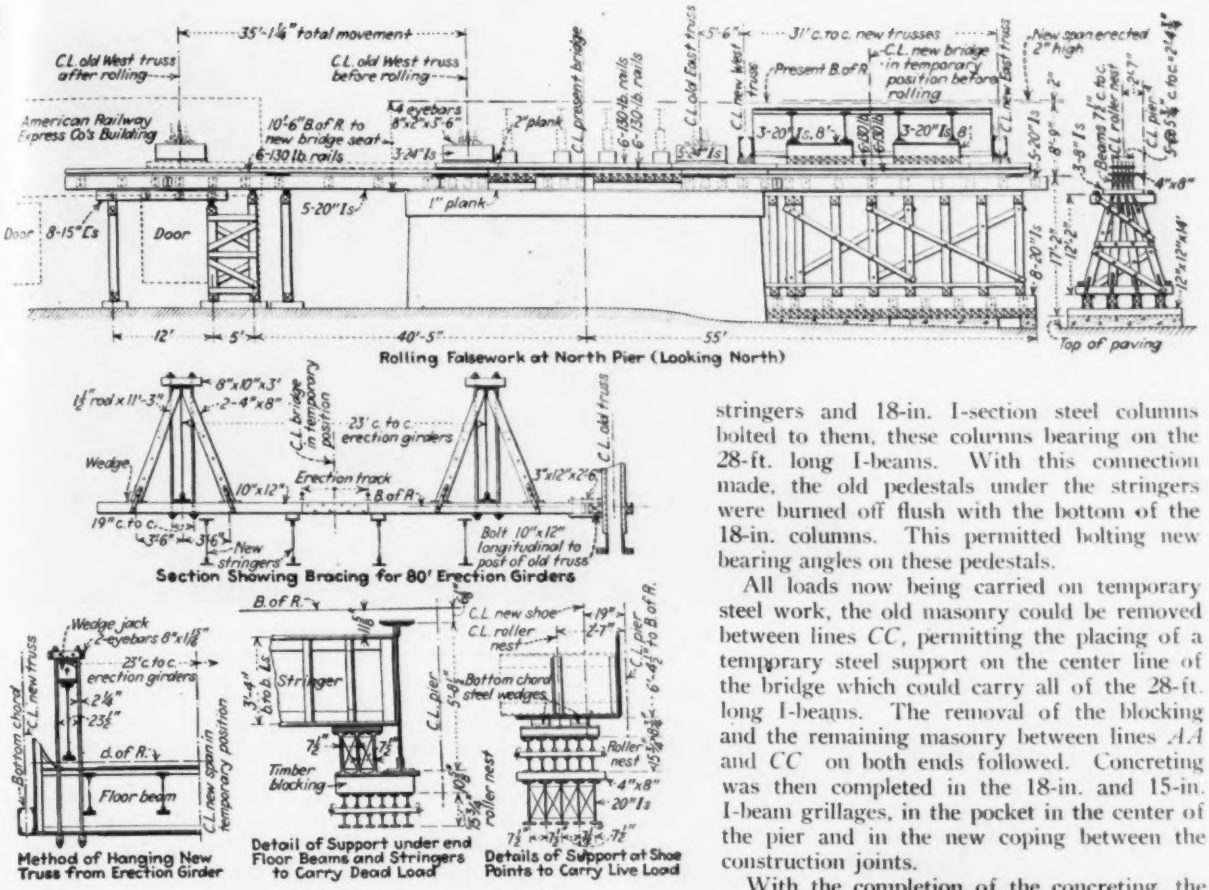


FIG. 5—FALSEWORK AND ERECTION DETAILS
Note the continuous falsework for simultaneously moving the old and new trusses.

groups of I-beams outside of lines *CC*, thus providing additional support to that offered by the new concrete under the ends. In order to make a connection between the old stringers and the 28-ft. long I-beams, holes were drilled in the outstanding legs of the end angles of the stringers and 18-in. I-section steel columns bolted to them, these columns bearing on the 28-ft. long I-beams. With this connection made, the old pedestals under the stringers were burned off flush with the bottom of the 18-in. columns. This permitted bolting new bearing angles on these pedestals.

All loads now being carried on temporary steel work, the old masonry could be removed between lines *CC*, permitting the placing of a temporary steel support on the center line of the bridge which could carry all of the 28-ft. long I-beams. The removal of the blocking and the remaining masonry between lines *AA* and *CC* on both ends followed. Concreting was then completed in the 18-in. and 15-in. I-beam grillages, in the pocket in the center of the pier and in the new coping between the construction joints.

With the completion of the concreting, the roller nests were placed under the end of the old span and blocking was inserted between the old shoes and the bottoms of the pedestals of the old end stringers and the top of the roller nests. This permitted the removal of the short 18-in. columns on the ends of the old stringers as well as the two 20-in. I-beams which supported the columns.

There remained, before completing the masonry alterations, only the building of a concrete wall on top of the new coping for the support of the ends of the deck plate-girder approach span. This was followed by the removal of the three 20-in. I-beams and the burning off below the upper surface of the new coping of the temporary steel support on the center line of the bridge.

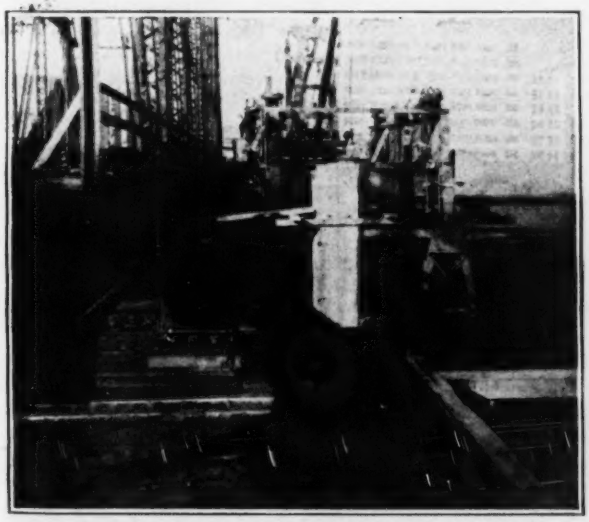


FIG. 6—ERECTING FALSEWORK FOR NEW SPAN
Note steel bent in center. Other bents of wood. Old span at left.

Falsework—It was necessary to erect falsework extensions to the piers both upstream and downstream to provide end supports for the new truss span in its temporary position and for the old truss span after it had been rolled downstream. For the erection of the new span it was also necessary to erect four falsework bents (Fig. 2) between the upstream pier extensions and so placed as to clear the existing B. & O. tracks. These were timber bents with the exception of bent *D*, which was of built-up steel members. Bents *A* and *B* had been erected at the beginning of the work and supported the temporary side track on 48-in. plate girders.

On this falsework were placed the girders for use in erecting the new truss span. Girders 65 ft. long spanned between bents *C* and *D* and girders 80 ft. long spanned between bents *D* and *E*. Between bents *E* and *F* six 20-in. I-beams were used. Rails and roller nests were placed on the pier extensions and the rollers blocked

against movement. Details of the rolling falsework as well as the falsework for erection of the new span are shown in Figs. 5 and 6.

In erecting the new truss span on the falsework, wedge jacks and hanger rods were placed over the erection girders to carry the floor beams as shown in Fig. 6. The bottom chords were then bolted to the floor beams and the new trusses erected by derrick car and completely riveted.

By releasing the wedge jacks the dead load of the span was carried through the end floor beams to the falsework extensions of the piers. This permitted the removal of the erection girders, the wedge jacks and the hanger rods as well as the removal of the falsework bents with the exception of bent *D*. This was left in place to provide support for the sidetrack extension after the new span was rolled into position. This sidetrack extension was formed by re-erecting the 80-ft. falsework girders from bent *D* to the falsework upstream from the north pier.

Before rolling the old and new spans it was necessary to remove part of the roof of the American Express Company's building downstream from the old bridge, since the old span moved into this area. With everything in readiness, the old bridge was rolled downstream and the new bridge rolled into permanent position and track restored within twenty minutes without interference with traffic. The rails and roller nests were immediately removed from the upstream side and the new shoes placed beneath the new truss. The new shoes beneath the downstream side were not placed until after dismantling the old span.

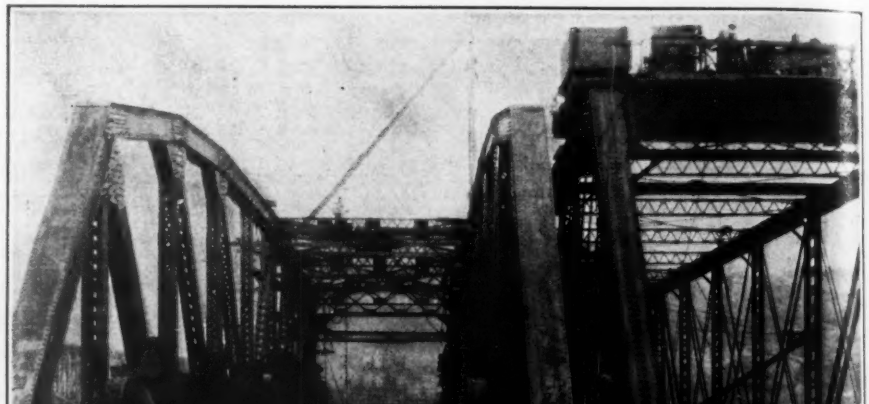


FIG. 7—NEW SPAN BEING ERECTED BESIDE OLD SPAN
Note jacking cables at bottom of end post of old truss.

The dismantling of the old span was accomplished by stiff-leg derricks operating from the downstream top chord of the new truss, removing the old steel to cars on the temporary sidetrack. However, prior to actual dismantling of the old bridge, it was jacked upstream about 2 ft. and its old upstream truss securely fastened to the new downstream truss of the new bridge. Then by means of the stiff-leg derricks the top and bottom diagonal lateral bracing and the stringers were removed and temporary struts placed for the support of the old downstream truss during the moving of this truss upstream about 24 ft. Channel and I-beam cantilevers were hung from the new downstream truss for supporting the two trusses of the old bridge. Thus supported, as shown in Fig. 8, the old trusses were dismantled (the downstream truss first) and placed on cars on the temporary sidetrack.

Administration—The erection plans were prepared and the work was performed by the Seaboard Construction Company, Philadelphia, Pa., under the personal supervision of S. P. Mitchell, president of the company. Thomas Berger was superintendent in charge of the field work. For the Pennsylvania Railroad, J. F. Leonard, engineer of bridge and buildings, supervised the work.

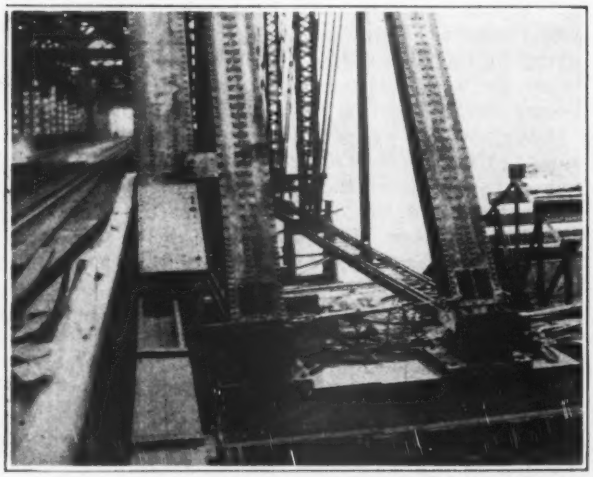


FIG. 8—OLD TRUSS IN POSITION FOR DISMANTLING
Stiff-leg derricks mounted on top chord of new span removed material to temporary sidetrack upstream shown in Fig. 1. Two trusses of old bridge moved in close to new downstream truss and rested on cantilever supports.

Highway Materials Located by Students

Considerable saving in the cost of Wisconsin highway construction has resulted from summer surveys made by geology students of the University of Wisconsin under the direction of E. F. Bean, state geologist. The parties make an intensive study of the country through which a road is to be built, in order to ascertain the location of gravel deposits and other materials near the proposed location. Use of these materials eliminates charges due to freight, truck hauls and rehandling. The field reports are sent to a materials engineer, who determines whether the materials are of the right quality and in sufficient quantity to justify their use in the proposed project.

Test of Curing Methods for Concrete Road Slabs

Half Width of Road Cured by Earth and Water and Other Half Divided Into Twenty Sections, Each Cured by Different Process

By D. D. McGuire
Engineer of Tests, Department of Highways, Nashville, Tenn.

SEVERAL methods of curing concrete roads have been employed in Tennessee, both as regular construction and for research purposes. An outstanding feature of the results has been the variation in strength when different kinds of earth were used for curing. The chart (Fig. 1) shows a possible variation of 16.7 per cent in the strength of beams cured with red clay and brown loam. Such a variation has naturally caused curing methods to be questioned, and a test road is being constructed in co-operation with the Bureau of Public Roads.

Route 15 through Fayette County traverses a relatively level section of southwestern Tennessee. The average humidity is low and the temperature is quite high. The subgrade conditions are the most uniform discovered on any stretch of road which otherwise might have been used. By a supplemental agreement with the contractor, the transverse dowel pins are eliminated and the cross-section of the pavement is thickened from 8-6-8 in. to 8-7-8 in. Also, the expansion joint spacing is increased from 50 ft. to 200 ft. One-half of the pavement (Fig. 2) is cured by the contractor by the regular earth-and-water method; the other half is cured by state forces as shown by the accompanying tabulation.

METHODS OF CURING CONCRETE SLAB ON TENNESSEE TEST ROAD

Section No.	Curing Medium	Manner Applied	Subgrade Treatment
1	Burlap 24 hr		
2	Burlap 48 hr		
3	Burlap 72 hr		
4	Burlap 96 hr		
5	No curing		
6	Sisalkraft 24 hr		
7	Sodium silicate	Surface application	Bare
8	Asphalt emulsion	Surface application	Bare
9	Calcium chloride*	Surface application	Bare
10	Calcium chloride†	Surface application	Bare
11	Tar, hot and cold	Surface application	Bare
12	Hunt process	Surface application	Bare
13	Hunt process	Surface application	Tar paper covered
14	Tar, hot and cold	Surface application	Tar paper covered
15	Calcium chloride†	Admixture	Tar paper covered
16	Calcium chloride*	Admixture	Tar paper covered
17	Asphalt emulsion	Surface application	Tar paper covered
18	Sodium silicate	Surface application	Tar paper covered
19	Earth partly wet		
20	Ponded		

*2 lb. per square yard. †2½ lb. per square yard.

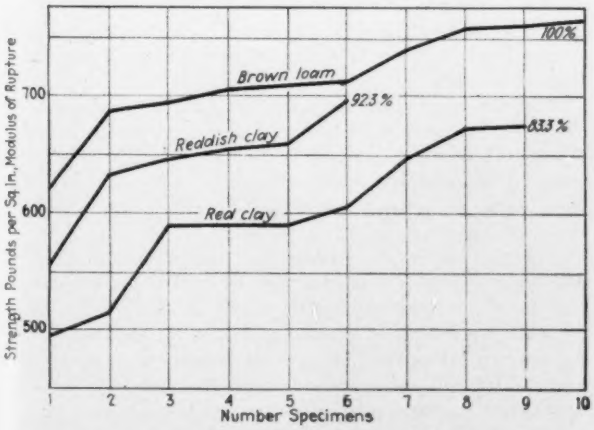


FIG. 1—VARIATIONS IN MODULUS OF RUPTURE DUE TO DIFFERENT KINDS OF EARTH USED FOR CURING

FIG. 2—ONE-HALF EARTH CURED; OTHER HALF CURED BY DIFFERENT METHODS

The dowel pins are eliminated so that if there be a difference in expansion between the research sections and the earth-cured sections, shear will be unhampered. The cross-section is thickened to offset the deficiency in design caused by eliminating the dowel pins, and the expansion joint spacing is increased in order to increase the expected difference in expansion.

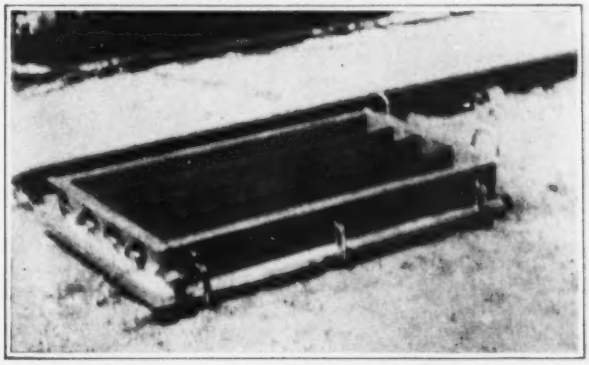


FIG. 3—GANG-MOLD FOR TEST BEAMS

From each half of the pavement, three sets of beams (6x6x46 in.) are made each day and cured as nearly as possible in the manner of the research section of the

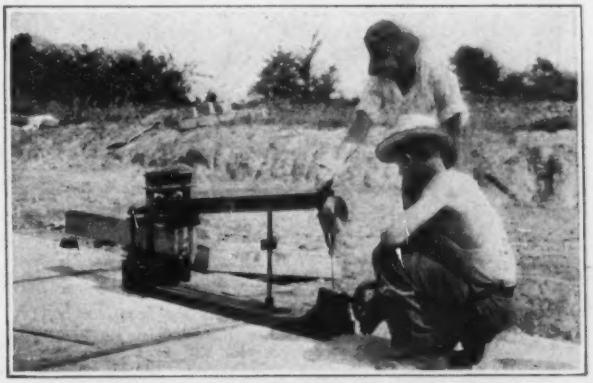


FIG. 4—BEAM-TESTING MACHINE MAKING FIELD TESTS

pavement. Three other sets are made at the same time and cured with wet earth. Each day a set of beams with no curing whatever is made as a control of concrete strength.

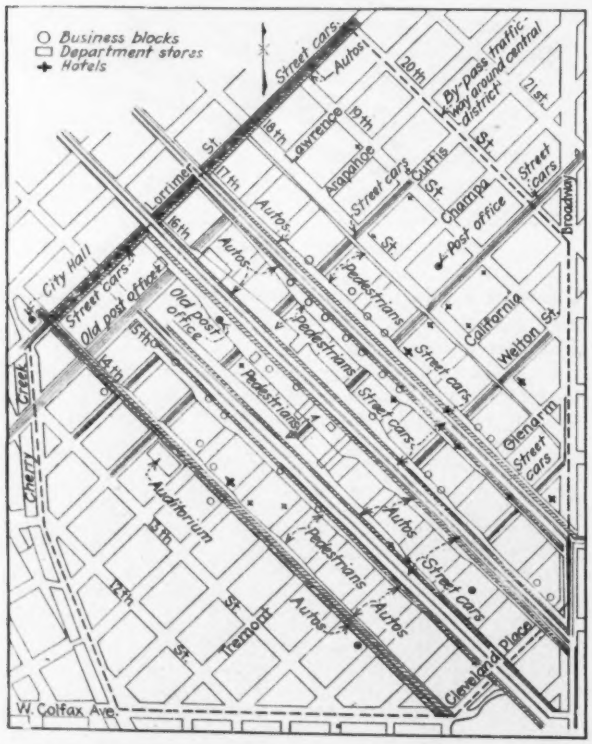
The beams are constructed in a gang-mold (Fig. 3) placed on the shoulder. The concrete is thrown in in shovelsful from alternate ends, and after a form has been filled, it is spaded and struck off. The dirt-cured specimens are covered with burlap for 24 hours, after which the forms are stripped and the beams are placed on the top of the earth-cured half of the pavement and given the same treatment as the slab. All beams are broken in 3, 7, 14 and 28 days with the transverse testing machine shown in Fig. 4, which is standard equipment in this state.

Relative Street Use by Pedestrians, Vehicles and Street Cars

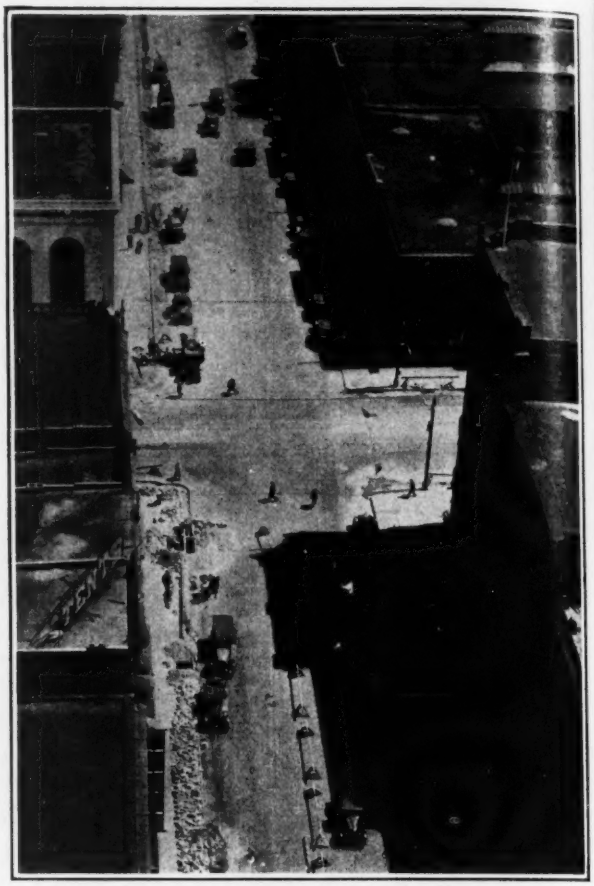
Belt Line Around Denver Business District Located After Ascertaining by Count the Actual Use of Street Area

Abstract of a paper presented to the Detroit meeting of the American Society for Municipal Improvements by S. R. DeBoer, city plan engineer, Denver, Colo.

ACTUAL use of street area by pedestrians, automobiles and street cars in the central business district of Denver, Colo., has been the determining factor in locating an interior belt line or major traffic street surrounding the district. The pedestrian count showed definitely the boundaries of the main shopping district, since at the



CENTRAL BUSINESS DISTRICT OF DENVER, COLO.
Of the three heavy traffic streets, Sixteenth St., a department and retail store street, carries the heaviest load of pedestrians. Street-car traffic is heavier on the two adjoining streets, banks and office buildings on Seventeenth St. and groceries and small retail stores on Fifteenth St.



WIDENING STREET UNDER TRAFFIC
Four feet was taken from the sidewalk first on one side then on the other, traffic being closed off from half the street at a time.

borders of the district the number decreased suddenly to a very low count. The belt line was located at the break in the count.

Denver's downtown streets are all 80 ft. between property lines and have 48-ft. roadways. The plan of the city called for a major traffic street to surround the shopping district. This interior belt line would consist of 56-ft. roadways, leaving 12-ft. sidewalks. Outside of this interior belt is planned a major belt line of great width and ornamental character. This belt line will have a width of about 120 ft. between property lines and requires a condemnation of property. The radiating major traffic lines end on this major belt line and use it to bypass the city.

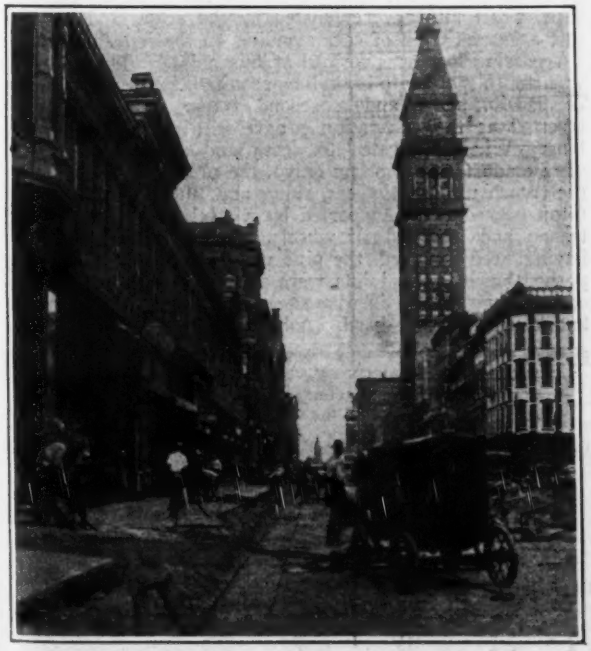
For the blocks where pedestrian travel was heaviest, 50,000 maximum in 24 hours, it was felt that the present 16-ft. sidewalks could not be reduced, but at the outer edge of the district, where the inner belt is located, the light count of pedestrians makes a reduction of sidewalk width from 16 ft. to 12 ft. possible.

Together with the pedestrian count, the number of persons using the street cars and automobiles were platted. On the main shopping street, where a maximum number of 50,000 pedestrians occurred, the count showed 14,202 persons traveling on one side of the street in street cars and 12,706 in automobiles. The number of motorists was arrived at by multiplying the number of autos by 1.5.

On the shopping street west of the central street, Sixteenth St., are found a far higher number of street

PAVEMENT BREAKERS DEMOLISH SIDEWALK SLABS

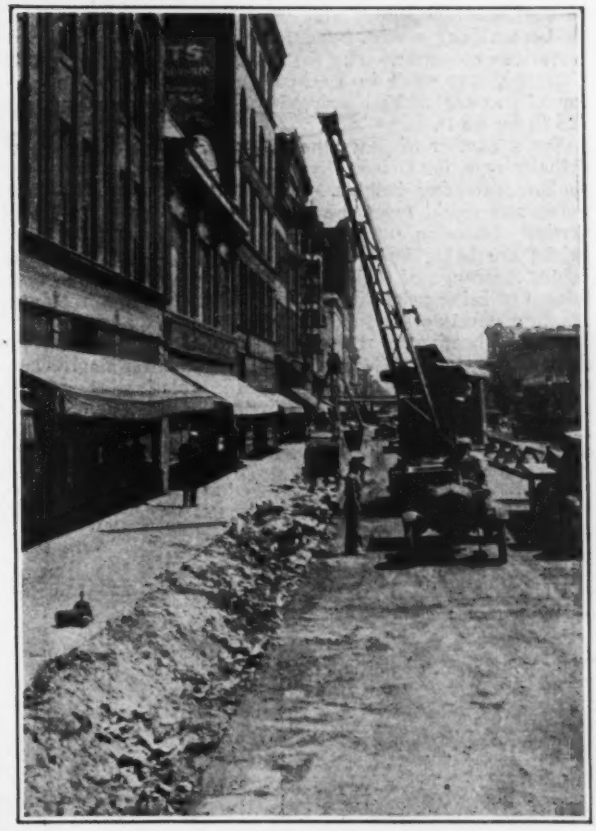
cars and passengers. In character this is a grocery store street and contains no department stores. The street east of the central street has about the same number of street-car and auto passengers, and about the same number of pedestrians, as the street west, or approximately one-half those using the shopping street. This street is a bank, railroad office and real estate office street. The district thus has a very decided division of use on the three streets. The change in character from the traffic standpoint seems to be indicated mainly by the number of pedestrians. The heaviest pedestrian street, indicated as the central street, is a decidedly department store street. The streets on either side of these through streets are of a different character. They do not carry street-car traffic, and automobile traffic is, accordingly, heavier. In spite of the fact that the post office and other public buildings are on these streets, pedestrian counts are light.



AIR COMPRESSOR FOR PAVEMENT BREAKERS USED TO BREAK UP SIDEWALK SLAB

The three comparative counts in Denver have mainly been of value to determine the character of the streets and to locate the inner traffic belt in such a way that it will be as close as possible to the inner shopping district of the city.

The counts show that the higher number of street-car passengers does not seem to encourage the department stores to move there. The heavy street-car traffic can well be located a block away from the department store street and still give it service. The count shows that banks do not need to be at the busiest corners but are well located a block away from the department store streets. It also shows that the heaviest pedestrian count



TRACTOR CRAWLER LOADING FORD TRUCK
After sidewalks were broken up by pavement breakers old curbs and débris were removed with crane.

is not on the street of the greatest number of office buildings but is decidedly on the department store street.

Some calculations were made in regard to the street space used for each type of traffic. In the central street the middle 20 ft. of the street carried 28,557 street-car passengers, or 1,428 persons per foot of street width. The automobile lanes on the 48-ft. roadway, of course, are not economical. They carried 25,412 passengers on 16-ft. widths (from the street width two lanes of parked autos must be subtracted), or 1,558 persons per foot of street width. These figures must not be confused with maximum capacity figures.

On the street west of the department store street the proportion is different, 20 ft. of roadway space used by the street cars carrying 42,058, or 2,103 persons per foot of street width. The number of motorists figured on the previous basis is 20,528 on a 16-ft. width, or 1,283 persons per foot of street width.

Letters to the Editor

Roller Gates on Dams Not Confined to Scandinavia and Germany

Sir—Having read the valuable article on "Roller and Sector Gates on Hydro Plants in Norway," by Oren Reed, in the Sept. 6 issue of *Engineering News-Record* and also having followed with interest the development of this very successful type of gate since the first installations in Scandinavia more than twenty years ago, I wish to add a few notes that might be of interest to your readers.

The roller gate was invented and developed in Germany by the well-known engineer Dr. Max Carstanjen, director of the Maschinenfabrik Augsburg-Nurnberg, and built at its Gustavsburg works, but later on also built by licensees in various countries. The first installation, at Schweinfurt, Germany, was made in 1902-03 and consisted of one gate for 59 ft. clear width opening by 13 ft. height and one for 115 ft. by 6.5 ft.

For a number of years the gates were built of the plain cylinder type, for comparatively wide openings, but for only shallow damming heights. With the development of the apron and shield types the gates increased considerably in vertical dimension, until now gates of up to about 30 ft. in height are being built and installed. With the increased height the range of their application was increased, so that instead of being primarily ordinary crest regulators they are the most effective flood gates for deep notches as well.

The application of the roller gate is not confined to Scandinavia, nor to Germany, where it was developed, but the type found use in modern hydro installations the world over. The following table gives the distribution of about 250 single rollers installed in approximately 140 installations completed or in course of construction:

Germany	140	Rest of Europe	14
Finland	20	United States	24
Norway	19	Mexico	4
Sweden	16	South America	3
Czechoslovakia	13		
			About 250

The largest gates are to be found in Scandinavia, Germany and United States. Data on some of these are given in the following table:

Installation	Country	Year	No. Gates	Width of Opening, Ft.	Height of Gate, Ft.	Area, Sq.Ft.
Raanaasfos	Norway	1919	1	147.50	21.30	3,148
Forshuvud	Sweden	1917	2	55.70	29.00	1,618
Solbergsfos	Norway	1919	3	65.60	28.70	1,885
Wamma	Norway	1913	1	91.80	11.50	1,055
Kleinwallstadt	Germany	1926	3	115.00	19.05	2,185
Viereth	Germany	1922	2	98.40	19.70	1,938
Long Lake	U. S. A.	1910	2	100.00	19.00	1,900
Bellows Falls	U. S. A.	1928	2	118.00	18.00	2,125
Trasquila	Mexico	1911	1	80.00	11.80	950
Trollhattan	Sweden	1907	2	65.60	13.12	860

In contrast with the few larger gates listed above, gates have been built for as low a height as 20 in., for as narrow openings as 18 ft. and of gate area as small as 65 sq.ft.

An important feature of the roller gate, of comparatively recent development and application, is the arrangement whereby it can be lowered below the bottom of the bottom sealing sill. There are often serious objections to the great wastage of water and loss of head attendant to opening the gates for sluicing out ice and débris. A design has been worked up and installation has been made by which the gate is dropped clear below the sill or bottom of the opening or, as is most customary in hydro practice, the gate is dropped 1 to 4 ft. below the pond level, which allows ice and other floating matter to pass over the gate. This gate has also found application in navigation locks, taking the place of miter gates, either by being dropped below the sill or, as in barge traffic might easily be accomplished, raised high enough to clear the vessel.

The arrangement of the detail of design for permitting the gate to be dropped below the sill is simple, consisting only of a square box of steel plate along the length of the bottom of the gate. This box communicates with the pond pressure by which the fourth side plate with attached seal-timber is held tightly against the machined sill plate.

Until recently the gate has had comparatively limited application in this country, perhaps due to its being patented and also due to its initial cost, which is high compared with other types of gates. Since the construction was taken up by a reliable hydraulic concern in this country some time ago, it is believed that this simple and reliable gate will find increased favor with hydraulic engineers. The Wallenpaupack, Bellows Falls and Leaburg installations are only the forerunners.

JOHN V. ZAHLEN,
Field Supervising Engineer,
Devils River Hydro-Electric Development.

Del Rio, Tex.,
Oct. 26, 1928.

Man-Hour Costs of Water Main Trenching and Pipe Laying

Sir—Following in the line of the article entitled "Man-Hour Costs of Water Main Trenching and Pipe Laying" published in your issue of Sept. 13, 1928, comparative details of two pipe-laying methods used in laying a 40-in. diameter cast-iron pressure main in this country may be of interest.

The work described consisted of excavating for, distributing and laying about 14 miles of 48-in. cast-iron pipe. The pipes were 12 ft. 4 in. long, they weighed about 10,000 lb. each and the average depth of cover was about 4 ft., laid parallel and close to but at slightly lower level than an existing 42-in. cast-iron main forming one link in the main water supply to the City of London. In addition to this 14 miles of "run work," other and "special" pipe laying was included in the contract. The details are for the most part, however, confined to the laying of the pipe "run work."

Work commenced in July, 1924, four main "run work" gangs, two pipe-distributing gangs and several "special" gangs being employed. The run work was first organized on the following lines:

The surface soil was stripped to a depth of about 12 in. and used as formation for a 7-ft. gage track on which a 3-ton steam crane operated. On the opposite side and over the existing main, a 60-cm. industrial track was laid and on this a small steam locomotive with two trains of 1-cu.yd. cars operated. Into the cars standing on the industrial track, the next 2½ ft. (about) was loaded by hand and run direct to backfill. Following this the top frame of timber was set up, a few short runners being inserted where they were necessary.

The ground varied from stiff clay to water-bearing sand and gravel; no rock was met with. The remainder of the trench, which varied from 7 to 14 ft. in depth, was excavated by hand and loaded into ½-cu.yd. tumbling skips; these in turn, when filled, were hoisted by the crane and emptied into a second train of cars standing on the industrial track. (A passing loop was formed at this point.) This material was run to spoil or to backfill as required, full-length runners of 9x3-in. space and a second frame of timber being inserted as the excavation progressed; wales were 16 ft. long. When excavated to depth and after "joint holes" were made (in the bottom only), the pipes were rolled over the trench on two timbers, slung and lifted by means of a 6-ton geared block supported by a steel gantry astride the trench and mounted on wheels. The timbers and struts having been removed, the pipe was lowered to its bed and pushed home. The joints were formed by first inserting a complete ring of ⅜ in. diameter lead rod into the socket, knocking this home hard. Asbestos jointing rings, clayed,

TABLE I—COMPARISON OF THE RATE OF PIPE LAYING
Four Main Gangs—"Run Work"

	From Nov. 12, 1924, to July 15, 1925			From July 15, 1925, to Nov. 18, 1925		
Gang	Weeks	Pipes	Per Week	Weeks	Pipes	Per Week
1	34	534	15.7	18	349	19.4
2	16	288	18.0	18	451	25.0
3	34	721	21.2	18	369	22.0
4	34	549	16.1	18	436	24.3
Average all gangs			17.8			22.7

Best Rate Any Period

Gang	Weeks	Pipes	Per Week	Period
1	8	166	20.7	March 4, '24, to April 29, '24
2	10	310	31.0	Aug. 12, '25, to Oct. 14, '25
3	6	191	32.0	Sept. 30, '25, to Nov. 4, '25
4	6	168	28.0	Sept. 30, '25, to Nov. 4, '25

were next fixed and run lead joints made. After running, the joints were knocked up by hand and as made were tested by means of a special machine traveling along inside the completed pipe. When passed, the trench was backfilled, timber drawn, the backfill well watered and rammed, track and material moved ahead and later the top soil replaced. Total lead per joint (including waste) was 110 lb.

It will be seen that a delay to any unit affected the whole cycle of performance and that the rate of progression was limited to the capacity of the crane. Good labor was available and the rate of progression from Nov. 12, 1924 (when all gangs were in full working order), till July 15, 1925, averaged 17.8 pipes per gang per week. Great difficulty was experienced in maintaining in an efficient condition the special joint-testing apparatus, the specification demanding a test pressure of 260 lb. per sq.in. Many delays were caused through the failure of this gear and the work fell behind the time schedule.

On July 13, 1925, the writer was instructed to take charge of this contract, reorganize it if necessary and complete the work within the time schedule. After investigation it was decided to replace all steam locomotives with gasoline tractors (these were available), reorganize the methods in use by three of the four gangs and transfer their cranes to other and special deep sections of the contract. With the approval of the engineers, the joint testing machines were withdrawn temporarily for thorough overhaul and the work of gangs 2, 3 and 4 was reorganized as follows:

As before, 12 in. of soil was removed and used for the formation of the 60-cm. track laid over the existing 42-in. main. Excavation was carried out by hand in stages to full depth, the surplus only being run to spoil, the remainder stored on the side opposite the 42-in. main. Pipes were laid, jointed and tested as before. From July 15, 1925, to Nov. 18, 1925 (when all pipes available had been laid), the average speed increased from 17.8 pipes to 22.7 pipes per gang per working week, the speed of laying being now controlled only by the speed of joint making (in the case of gangs 2, 3 and 4).

It was found that, with a crew of seven men on an average, six joints, each with 110 lb. of lead, could be run and knocked up per shift of eight hours. For this rate of progression the gang's strength was organized and averaged about 120 men, unskilled labor fluctuating as the requirements of muck shifting, etc., demanded. Normal strength was as follows:

	Men
Stripping soil	2
Excavating first lift to wagons	22
Fixing top frame of timber	4
Excavating remainder in stages	30
Fixing second frame and runners	6
Attending pumps	1
Running surplus to spoil and leveling	6
Laying pipes	7
Running and knocking up joints	7
Backfilling, ramming and drawing timber	18
Testing joints (two boys)	3
Moving material forward, lifting and laying track, etc	11
Tools and tea (boys)	2
Standing ganger	1
Total	120

Tables I and II give details of speed and costs for each gang. Table III gives comparative "period" costs. From these it can be seen that the work as a whole was speeded up approximately 23 per cent, while the reduction in cost was 14 per cent.

Little improvement was made in actual detail costs by this revision of methods, but the increased rate of progression materially lowered total costs. In the case of gang 1 the improvement was due solely to the competitive spirit, as this gang now endeavored to compete with the alternative method; this was fostered by a bonus. In the case of gang 3, as this gang was forced to lay "specials," its rate of progression was slowed, with a corresponding increase in the cost of laying and jointing pipe.

The work was carried out by (the late) contracting department of Sir W. G. Armstrong, Whitworth & Company, Ltd., Westminster, for the Metropolitan Water Board, London.

T. F. YOUNG,
Assoc. M. Inst. C. E.
Toomebridge,
County Antrim, Ireland,
Oct. 11, 1928.

TABLE II—LABOR COSTS ONLY OF THE FOUR MAIN ITEMS OF RUN WORK

Period From Aug. 5, 1925, to Oct. 21, 1925

Gang	Excavate Timber. Pump Run Surplus to Spoil, Per Cu.Yd.	Handle and Lay Pipes, Per Lin. Yd.	Run and Make Joints, Per Joint	Backfill and Draw Timber, Per Cu.Yd.	Total, Per Lin.Yd. Laid £	s.	d.
1	5/7	3/2	14/8	1/1	2	9	7
2	5/2	3/2	12/3	1/8	2	9	3
3	6/–	4/9	16/6	1/4	2	15	8
4	5/8	3/9	15/7	1/8	2	13	10

Gang 1 in gravel water bearing in parts. Using crane. Average depth 10 ft. 9 in. Normal "run work" crossed two roads; traffic diverted one road, other bridged.
Gang 2 in gravel, sand, clay, no water, all hand excavation, average depth 8 ft. 10 in. Normal "run work" crossed two roads, both bridged.
Gang 3 in stiff clay, no water, hand excavation. Reversed grade once. Laid one "special" length, jumped one "special" length, jumped one road. Average depth 8 ft. 8 in.
Gang 4 in stiff clay, no water, hand excavation. Average depth 8 ft. 6 in. Crossed two roads, both bridged, jumped two "specials." Hung up at one road waiting for gas company to relocate main.
Note—These comparative costs are based on a normal depth of trench giving 4 ft. of cover; depth varied from day to day and from gang to gang.

TABLE III—TOTAL COST OF RUN WORK

Item	Units	From Commencement to July 29, 1925 £	s.	d.	July 29, 1925, to Nov. 18, 1925 £	s.	d.
Excavation, cu.yd.*	6¾	6/1	2	0	7	5/9	1	18	4
Lay pipe, lin.yd.	1	5/–	..	5	0	4/–	..	4	0
Joint pipe, number	½	18/1	..	4	6	14/10	..	3	8
Backfill, cu.yd.	5.15	1/7	..	8	2	1/7	..	8	2
Handle pipe, lin.yd.	1	6/1	..	6	1	6/5	..	6	5
Lead per joint	½	38/–	..	9	6	38/–	..	9	6
Use and waste of timber	....	....	..	5	7	.....	..	5	7
Temporary buildings	....	....	..	..	11	.....	..	..	11
Net cost, lin.yd.	....	....	4	0	4	.....	3	16	7
On cost, 39 per cent	....	....	1	11	4	25%	..	19	2
Total costs, lin.yd.	....	....	5	11	8	.....	4	15	9

*Includes pumping, disposal of surplus, timbering and withdrawing timber.

Relation Between Output and Cost in Mixing Concrete

Sir—In *Engineering News-Record* of Sept. 27, 1928, p. 472, there appears an interesting article by William C. McNaughton entitled "Relation Between Output and Cost in Mixing Concrete." Accompanying the article are two graphs indicating the relation between output of concrete and its unit cost per cubic yard.

It is stated that in preparing the diagrams the data considered included only the labor cost of mixing and placing—that is, the cost from the time the concrete materials were delivered at the mixer until the concrete was poured into the forms. No data are given to indicate what equipment was used for mixing the concrete materials nor for transporting the materials from the mixer to the forms. Mr. McNaughton's conclusions are that his curve has possibilities in solving a problem where the actual cost of work is known and where it is desired to compute the cost of the same piece of work assuming that it were done at a different rate of progress. Frankly, the writer can see no application of his curves to any other than the particular job from which the curves were derived.

The writer believes that the author's conclusions would be much more forcible if supporting detailed data were given for a few examples to indicate what costs actually were used in the examples plotted in the graphs and from which the author's curves and conclusions were derived. Without such supporting data, it would seem impossible to arrive at any worth-while conclusion, because the labor unit costs of mixing and placing concrete depend much more upon the equipment provided than upon the speed, or output, actually accomplished in mixing and placing the concrete.

There are two distinct operations covered by the graphs—namely, the mixing of the materials in the mixer and the transportation of the mixed concrete to and into the forms. In order to secure economical mixing and placing of concrete, it is essential that these two operations synchronize. If they do not, then the cost of mixing and placing the concrete is increased above the minimum. Generally speaking, the ideal arrangement of equipment and man power is such that the

speed of the entire operation is determined by the length of time during which materials are retained in the mixer. The operations of getting the materials to the mixer and away from the mixer to the forms should function so that there is no delay at the mixer, which should operate continuously and at a uniform speed. With this arrangement, the labor cost of mixing and transporting the concrete is a minimum with any particular outfit.

On the other hand, if there is a delay in either of the two operations, the unit cost of the concrete at the forms is increased. It is the duty of the superintendent in charge to see that there is no such delay. In the event that the two operations discussed above are always maintained in the proper way when concrete is being mixed and placed, it is not apparent that the total output per month has anything to do with the unt cost. The total monthly output depends solely upon the total number of hours during which the mixer is operated. Increased unit cost for labor can be increased only through delays or through uneconomical handling of labor required for mixing and transporting the concrete. In most instances the transportation of the concrete from the mixer to the form is the only real problem on the job materially affecting unit labor costs. Although Mr. McNaughton does not discuss this feature, it seems reasonable to assume that the examples plotted to show increased unit cost and less output are at least in part the result of difficulties that were experienced in transporting the concrete from the mixer to the form.

The writer has in mind particularly an operation which he is conducting at Springfield, Mo., involving the placing of 16,000 cu.yd. of concrete, the greater part of which is from a central mixing plant. This plant includes elevated storage bins holding more than sufficient material for one day's operation of the mixer and a 1-yd. concrete mixer, the bottom of which is placed about 10 ft. above the top of the finished work. This plant is located on the side of a hill, and a ramp, extending from the roadway to the top of the elevated storage bins, permits the trucks carrying the concrete materials to discharge directly into the bins. These materials, therefore, flow into and through the mixer by gravity. From the mixer the concrete is conveyed to the forms principally by buggies that are wheeled on wooden runways.

It has been found necessary and desirable to retain the concrete materials in the mixer two minutes, and this period of time determines the output of the plant. The only variable labor incurred in mixing and placing the concrete is brought about by variation in the length of runway required and in the corresponding number of concrete buggies used to transport the concrete from the mixer to the forms. The number of buggies used has varied from five to nine. The mixer has operated continuously during the day at uniform speed, so that during the day's operation each yard of concrete has been placed at practically the same unit cost. It is obvious that with such a plant the labor cost per cubic yard depends in no way upon the number of hours of operation nor upon the number of cubic yards placed per month. However, other factors not discussed in Mr. McNaughton's paper such as costs of forms and of runways have materially affected the unit cost of the concrete in place.

It is also obvious that the rate of progress in mixing and placing concrete for a single operation is determined by the capacity of the mixer and the time of retention of the materials in the mixer. However, the total output from the mixer during a month is determined principally by such operations as the preparation of forms and of runways required before concrete can be mixed and placed.

In view of the above it would seem to the writer that Mr. McNaughton's conclusion as to the relation between monthly output and unit costs of handling concrete should be accompanied by sufficient substantiating data of actual detailed costs as are required to explain the points shown on his graphs.

In a general way, as stated above, the variations in labor unit costs indicated in the article would seem to be largely attributable to distribution or transportation problems incident to the particular job in question. It does not appear that the conclusions reached by the author are of general application except perhaps to work of similar character and with similar equipment. To be of general application, the article should contain substantiating data of detailed costs and of equipment and methods used in handling the work. Every contractor knows that delayed progress increases unit costs of work. The difficulty is to determine and to eliminate the contributary causes for the delay. Sometimes the cure is more expensive than the disease.

Columbus, Ohio,
Oct. 25, 1928.

PHILIP BURGESS,
President, Burnip Construction Company.

Supply and Demand

Sir—Your editorial on "Supply and Demand" in the Nov. 8 issue brings up the much-discussed question of engineers' salaries and what can be done to better them. It is something I have thought much about and I would offer a few ideas for what they are worth.

If there is to be a general betterment of salaries, it must start somewhere. Where? I believe in general the salaried engineer falls into three classes. There is the teaching class, those who work for large public offices such as the highway departments and the city offices of the large cities and those who work for large privately owned engineering firms.

The schools cannot, for a number of good reasons, set the standard for engineering salaries. The politically controlled engineering bodies might be able to do it, but my natural optimism fails to believe it. This leaves the burden on the privately owned engineering organization which employs a large number of men. In other words, until the engineers themselves, who employ other engineers, really decide and believe what a certain class of engineering responsibility is worth in dollars it will be hard to convince others along that line. The public is likely to make odious comparisons. They would say, "Why should our city pay such a sum for a designing engineer when the Blank Engineering Company pays only half as much?" The example would be just as forceful and in the right direction if the engineer in private employ could be put up for comparison.

The engineer who sits on a committee to tell some large city what its engineering employees should be paid and then goes home and keeps his employees working on a smaller salary than he recommends is the real stumbling block. I believe it is only the large engineering concern the services of which are in continual demand and which is thus in position to pass the expense along which dares put its engineers on the right basis. When and if such a move is made the leaven should spread through the whole loaf.

Ames, Iowa,
Nov. 10, 1928.

L. W. MAHONE,
Consulting Engineer.

Well Points for Lowering Groundwater

Sir—In your issue of Oct. 11 Francis H. Kingsbury, assistant engineer, Massachusetts Department of Public Health, quotes Howard A. Carson, who as chief engineer of the Board of Metropolitan Sewage Commissioners described what Mr. Kingsbury declares "one of the first instances of unwatering an excavation by wells driven outside of the excavation." This work was in the vicinity of Boston, and the dates given are 1891 and 1892. The closing paragraph of Mr. Kingsbury's letter follows: "If any reader of *Engineering News-Record* knows of the earlier use of similar methods for unwatering excavations, it would be interesting to have them cited."

This method was used in 1889 during the construction of the No. 2 Ridgewood pumping station for the city (now borough) of Brooklyn, N. Y., which required footings 17 ft. below the existing normal water level.

To cope with this condition a series of 40 wells 2 in. in diameter with 4-ft. well points covered with No. 22 gage slotted brass gauze were driven to a depth of 30 ft. each. All in turn were connected to a 12-in. cast-iron suction main with 3-in. cross-suctions. After 21 days of continuous pumping 1½ million gallons the water level was under complete control at the required elevation for construction purposes of ten months' duration.

EDWARD PHILLIPS,
Consulting and Associate Contracting Engineer.

New York, N. Y.,
Oct. 30, 1928.

News of the Week

I.C.C. Approves Plans for New Chicago Produce Terminal

Approval of plans for the acquisition and financing of a new produce terminal in Chicago was announced by the Interstate Commerce Commission in a report and order made public Nov. 23. As approved, the plan involves the acquisition of approximately 23 miles of terminal tracks and facilities and the construction of approximately 23 additional miles by the Chicago Produce Terminal. The company will be controlled by the Atchison, Topeka & Santa Fe Railway and the Illinois Central Railroad, with provision for other railroads to participate in the plan if desired. The site of the new terminal is known as the South Water Market and is the present center of the wholesale produce trade in Chicago.

Texas Railway Extension Proposed

Authority to construct approximately 66 miles of new main line track in Texas has been requested of the Interstate Commerce Commission by the South Plains & Santa Fe Railway Company, now under lease to the Panhandle & Santa Fe. The new road, to be operated by the latter system, will extend from Seagraves, Tex., through Gaines County, Texas, and Lee County, New Mexico to serve agricultural territory and an oil field at present without means of transportation.

Western Electric to Build Cable Factory at Baltimore

Acquisition of 125 acres of land at Baltimore, Md., has prepared the way for the erection of a $15,000,000 telephone cable factory by the Western Electric Company. This will be started as soon as title to the property has been conveyed. The construction contract has already been awarded to the H. K. Ferguson Company, Cleveland, Ohio, and it is expected that the first unit in the new plant will be completed by the end of 1929.

Boston Dedicates North Station

Although it has been in use in an unfinished condition for several weeks, the formal dedication of the new North Station of the Boston & Maine Railroad in Boston, Mass., did not take place until Nov. 14, just one year after the first public announcement of plans for its construction. The new terminal building will include not only a modern passenger station but also a thirteen-story office building and a sport arena seating 17,500 persons. Provision has also been made for the erection of a hotel on the property, and it is expected that a formal announcement regarding plans for this structure will be made in the near future. During the entire period of reconstruction the site of the new station was used as a passenger terminal, and it is estimated that this was used by approximately 24,000,000 while construction work was going on.

Large Pipe Contract Awarded

Seven miles of 8½-ft. steel pipe will be supplied to the Bureau of Water of Philadelphia, Pa., by the Witt-Humphrey Steel Company, Greensburg, Pa. This is one of the largest water pipe contracts ever let in a single contract. Approximately 20,000,000 lb. of steel will be required. The pipe, of ⅝-in. steel, will be shipped in 38-ft. sections, one to a car, each section weighing about 26,000 lb. It will be dipped in a special bath of hot asphaltum.

Kill van Kull Bridge Contract Awarded

THE Port of New York Authority has awarded the contract for the steel superstructure of the Kill van Kull bridge between Bayonne, N. J., and Port Richmond, Staten Island, to the American Bridge Company for $5,041,770. The furnishing, delivery and erection of 26,000 tons of structural steel work in the arch and approaches are included in the contract. The main span will have a length of 1,675 ft.

A.I.S.C. Elects Officers

The American Institute of Steel Construction, at the annual convention Nov. 13-18 at Biloxi, Miss., elected the following officers: President, Charles N. Fitts, New England Structural Company, Boston; first vice-president, C. M. Denise, McClintic-Marshall Company, Pittsburgh; second vice-president, Clyde MacCornack, Phoenix Bridge Company, Phoenixville, Pa.; treasurer, George Pistor, Hay Foundry & Iron Works, New York City; assistant treasurer, L. L. Gadd, Levering & Garrigues Company, New York City. It was agreed to increase the tonnage assessment on members for the coming year in order to provide additional funds for the Institute activities. The next convention will be held in the early part of November, 1929, at Biloxi. A full report of the convention was given in our issue of Nov. 22, pp. 772-773.

Civil Engineers Vote 12 to 1 to Join Engineering Council

As we go to press, a vote of 3,991 for to 324 against is announced as result of the referendum vote of the American Society of Civil Engineers canvassed Nov. 26 on authorizing the board to join American Engineering Council.

The question submitted to the members contemplated changes in the structure and procedure of the Council such as to (1) make more effective balance of representation between large national and small local societies, (2) reserve the right of any member society to express opinions differing from those of the Council, and (3) provide for fuller veto power of strong minority elements on proposed actions of the Council. These changes have not yet been made, but it is understood will be made by the membership of the Council at an early date. It is understood that the board of direction of the society will take no action under the authorization of the vote just canvassed until the changes are completed.

Dallas Dam Accepted

Formal acceptance of the dam at Lake Dallas from the W. E. Callahan Construction Company was recently announced by the Dallas city council. This releases the contractor from a $1,000,000 surety bond which has been in effect during the past year, since the structure was completed. The action was taken on the recommendation of a board of engineers specially retained to make final examination of the dam and reservoir.

Research Board to Consider Roadbuilding Problems

At the annual meeting of the Highway Research Board of the National Research Council, to be held in Washington, D. C., Dec. 13-14, the proceedings will cover many points of interest to the roadbuilder and highway engineer. According to the preliminary program recently made public, the following topics will be among those to be discussed: practical methods based upon sound research for taking care of unusual drainage and other subgrade conditions, and for methods for design of pavements; new developments in finishing bituminous surfaces; factors to be considered in correlation of soil and pavement conditions; design of guard rail based upon extensive research in Pennsylvania; properties of bituminous materials for surface treated roads; safety on highways as affected by rural or urban conditions, degree of improvement of roadway, light or heavy traffic, increasing volume of traffic;

effect of width of roadway and various physical conditions upon carrying capacity; the Maryland aerial traffic survey between Washington and Baltimore; methods used in promoting the financing of state highway systems; sound economic principles in financing road improvements; research work of the National Safety Council.

All persons interested in any phase of highway development are invited to attend.

J. L. Campbell Heads Engineers of Northwestern Pacific R. R.

Appointment of J. L. Campbell to the post of chief engineer of the Northwestern Pacific Railroad was announced Nov. 16. Mr. Campbell, who is a member of the American Society of Civil Engineers and a past president of the American Railway Engineering Association, entered railway service in 1894 as resident engineer on the construction of the Rio Grande Northern. In 1897 he was appointed chief engineer of El Paso & Northeastern, and subsequently of the St. Louis, Kansas City & Colorado. Upon completion of construction work, he was made engineer of maintenance of way for the El Paso & Southwestern System, and later chief engineer of the same company, which position he held when it was consolidated with the Southern Pacific System.

Engineering Examiners Hold Meeting at Little Rock

The annual convention of the National Council of State Boards of Engineering Examiners was held Nov. 19-20 at Little Rock, Ark., under the auspices of the Arkansas board. The first business of the convention was to send a congratulatory telegram to President-elect Herbert C. Hoover assuring him of the co-operation of all state engineering boards. A list of engineering schools of recognized standing was approved for use by the various boards in giving credit for graduation to applicants for registration. A committee was appointed to compile a report including the regulations and procedure as to engineering registration of all state boards.

In his address to the convention George E. Taylor, retiring president, stressed the fact that the ultimate goal toward which the organization is working is an ideal condition in which all states will have registration laws of approximately equal requirements, so that reciprocity privileges can be easily and cheaply granted. Registration, he declared, is for the better protection of public health and safety and is gradually coming to have the support of the profession.

New officers were elected for the coming year as follows: president, James R. Rhyne, Arkansas; vice-president, C. G. Massie, Virginia; secretary-treasurer, T. Keith Legare, South Carolina. The next convention will be held in August, 1929, at Yellowstone National Park, Wyoming.

Coolidge Dam Closure Effected and Storage Begun Nov. 15

On Nov. 15 the heavy gate built to close the opening through which the Gila River passed through the Coolidge dam during construction was dropped into position and reservoir storage was thereby begun. Details of the closure will be described and illustrated in a later issue. Description of construction methods used on the Coolidge dam appeared in *Engineering News-Record*, Sept. 20, 1928, p. 438.

Long-Time Editor Goes to Chicago As Executive

E. J. Mehren, Former Editor of "Engineering News-Record," Becomes McGraw-Hill Head in Mid-West Metropolis

BECAUSE of the growth of its publishing operations, the McGraw-Hill Publishing Company is having erected for it in Chicago a building to bear its name and for the first time is placing there a resident vice-president as head of its Chicago interests. Edward J. Mehren, long-time editor of *Engineering Record* and *Engineering News-Record*, has been named to this important post. He will

EDWARD J. MEHREN

discharge his executive functions in addition to the editorship of *The Magazine of Business*, which position he recently assumed, as announced in our issue of Sept. 17.

Mr. Mehren's brilliant career in engineering and publishing, extending over a period of 22 years, is well known to all members of the profession. He is a native Chicagoan and a graduate of the University of Illinois, and except for some years of work in the engineering department of the Burlington and the St. Paul railroads, has been with the company throughout his active career. Joining *Engineering Record* as associate editor, he became in succession editor of the paper, editor of its successor, *Engineering News-Record*, vice-president in charge of publication of four of the company's magazines, and vice-president and editorial director. From this service he now goes to the larger and more responsible field of work intrusted to him in Chicago.

McGRAW-HILL BUILDING, CHICAGO

Four papers are now published by the McGraw-Hill company in Chicago: *The Magazine of Business*, *Factory and Industrial Management*, *System*, and *Harvard Business Review*, the latter published for the Harvard University School of Business Administration. A fifth magazine, *Industrial Engineering*, will shortly be transferred from New York to Chicago. The company has long maintained a large Chicago organization, including editorial, sales and circulation staffs, and thus has been closely in touch with the great engineering and industrial progress of the Middle West and its still greater potentialities. To be more intimately a part of that development, the company had long planned to publish part of its group of papers there. Thus the present establishment of the greater publishing house in Chicago, housed in its own building and in charge of a resident vice-president, is the logical outgrowth of progressive development.

Program Announced for Asphalt Paving Conference

The seventh annual Asphalt Paving Conference is to be held Dec. 3-7 at New Orleans, La., under the auspices of the Asphalt Association and the Association of Asphalt Paving Technologists. Although no formal activities other than registration are scheduled for the first day, Dec. 3, delegates are invited to attend the sessions of the South-Central Division, American Highway Traffic Association, and an informal reception will be held during the evening. The serious work of the conference begins on the morning of Dec. 4,

at which time the formal addresses of the two presidents will be heard, as well as welcoming speeches from Huey P. Long, Governor of Louisiana; A. T. O'Keefe, Mayor of New Orleans; O. K. Allen, chairman of the Louisiana State Highway Commission, and John Klorer, commissioner of public property of New Orleans. Papers will also be presented on the economics of asphalt pavement construction, as affected by mechanical equipment and operation, by T. Warren Allen, U. S. Bureau of Public Roads, and as affected by materials and control methods, by M. H. Ulman, Pennsylvania State Highway Department.

Parallel sessions are scheduled for the evening of Dec. 4. While the members of the A.A.P.T. are holding a business meeting, a separate session will be held to hear, among other papers: "Asphalt Construction and Treatment for Airport Runways," by Arthur H. Blanchard, consulting engineer; "Soil Investigation and Subgrade Treatments," by F. H. Eno, Ohio State University; and "Requirements for Asphalt Filler for Brick Pavements," by A. S. Rea. R. Keith Compton, president of the American Road Builders Association, will preside at this meeting.

The general topic at the meeting Wednesday morning, Dec. 5, will be "Service Results From Use of Asphalt in State and Provincial Highway Construction." Under this head seven papers giving results obtained in their respective states will be given by V. R. Burton, Michigan; W. R. Neel, Georgia; V. L. Ostrander, Massachusetts; R. M. Smith, Ontario; John D. Waldrop, North Carolina; T. C. McEwan, J. E. Moreland and F. W. Webster, Tennessee; and James M. Fourmy, Louisiana. The presiding officer at this meeting will be John N. Holder, chairman of the Georgia State Highway Board. At the evening meeting, under the auspices of the A.A.P.T., there will be presented a number of committee reports and technical papers dealing with laboratory tests and controls.

The morning session Dec. 6 will survey prevailing trends and practices in surface treatment. Five papers are scheduled, the closing one, by Prof. H. J. Hughes, of the Harvard Engineering School, being on the general topic "The Economics of Conserving Our Investment in Existing Highways." The fifth and last of the formal sessions, the afternoon of Dec. 6, will be devoted entirely to applied paving research, five papers being scheduled.

To Build Transmission Line in Tennessee

Contracts have been awarded by the Tennessee Electric Power Company and its subsidiary, the Nashville Railway & Light Company, for the construction of 58 miles of steel tower transmission line, 14 miles of which will be double circuit, and 51 miles of wood pole lines. The work will be done by Stevens & Wood, Inc., of Nashville and New York. The construction of four new substations is also included.

Frank H. Smith Elected President of Portland Cement Association

Chicago was the scene of the 26th annual meeting of the Portland Cement Association held Nov. 19-21. Frank H. Smith, of the Lawrence Portland Cement Company, was named president, Charles F. Conn, Giant Portland Cement Company, first vice-president; J. B. John, Sandusky Cement Company, second vice-president, and John L. Senior, Consolidated Portland Cement Company, treasurer. The first day,

FRANK H. SMITH

Nov. 19, was given over to meetings of the board of directors and various committees covering papers for mill sessions, conservation, transportation, accident prevention and insurance, accounting, advertising, technical problems, elimination of waste in selling, and packages. On Nov. 20 there were both morning and afternoon sessions at which four committees presented reports and two formal papers were heard: "The Influence of Fineness of Raw Materials on the Burning of Portland Cement," by R. H. Bogue, the association fellow at the U. S. Bureau of Standards, and "Ball and Tube Grinding," by Harry W. Newton.

On the third day a business session was held at which the remainder of the committee reports were received and the various business of the association transacted. G. S. Brown, retiring president, declared in his address that the cement industry has a bright future, although he qualified this by the statement that mills serving the seacoast districts were feeling the effect of foreign competition. Mr. Brown stated that during the past ten years 290,000,000 barrels of cement had been used in road and street paving, and 6,500,000 barrels in the manufacture of concrete sewer pipe. He also drew attention to the service feature of the association, the information bureau, which has satisfactorily handled thousands of inquiries regarding the use of cement.

Mr. Smith, in his speech of acceptance, stated that the association membership represented more than 90 per cent of American cement production, and alluded to the over-built condition of the cement industry and the menace of imported cement as the real problems of the future. He stated that the whole-hearted support of the entire industry is necessary to secure a protective tariff sufficient to maintain the present wage scale. At the close of the meeting a formal resolution was adopted urging Congress to remove cement from the free list, and to impose a duty which will uphold the present American standard of living among the workers in the cement industry.

The convention closed with a formal dinner at which the last bond issued to finance the building of the association at Chicago was burned. The principal speaker at the dinner was O. H. Cheney, vice-president of the American Exchange-Irving Trust Company of New York and member of the U. S. Chamber of Commerce, who declared that "a new era of vitality and usefulness is about to begin for the trade associations." He praised the cement association as an inspiring example for all industries, and made a plea for improved trade practices, sounding a warning against abuses likely to grow out of excess capacity and the fear of idle machinery.

Burlington Opens 202-Mile Line

Formal opening of the 202 miles of new main line of the Colorado & Southern division of the Chicago, Burlington & Quincy Railroad took place Nov. 20. The new road, which is said to be the most extensive main-line construction west of the Mississippi since the war, leaves the present Quincy tracks at Estelline and runs to Sterley junction, from which point lines diverge to Dimmit, Silverton and Lubbock, Tex. The cost of the extension is reported as $7,500,000.

Oscar Erlandsen Named Head of Queens Sewers

As a result of the recent change of administration in the Borough of Queens, New York City, Oscar Erlandsen, member of the American Society of Civil Engineers and of the Municipal Engineers of the City of New York, has been placed in charge of all sewers in the borough. Mr. Erlandsen has a notable record in engineering affairs. He graduated from the College of the City of New York in 1884 with the degree of B.S., and secured his C.E. from the same institution in 1887. Shortly thereafter he became assistant engineer with the Union Bridge Company on the construction of the Poughkeepsie bridge over the Hudson River and, in 1889, engineer of bridges for the Pennsylvania, Poughkeepsie & Boston Railroad, where he was in charge of all masonry bridges and trestles on the entire 95 miles of road. This was followed by a year's experience in railroad construction and seven years of bridge design and construction in New York. After a brief period of hydro-electric power plant design, Mr. Erlandsen became an assistant engineer in the de-

partment of bridges of the city of New York, working on the design and, later, the construction of the Queensborough bridge over the East River. In 1905 he became chief engineer of design for the O'Rourke Engineering Company on a number of well-known undertakings, including the Grand Central Terminal improvement, the Pennsylvania Railroad tunnels under the Hudson River, and foundations for the Hudson Terminal Buildings, the Altman Building, and the City Investing Building.

In 1907 Mr. Erlandsen became associated with the Metropolis Engineering Company, Jamaica, N. Y., of which he became the owner in 1911. Since that time he has been in private practice, principally upon municipal work.

To Extend Flin Flon Railway

Work is to be commenced at once on the construction of a branch line connecting the recently completed Northern Manitoba Railway, usually known as the Flin Flon Railway, with the copper property of the Sherritt-Gordon Company at Gold Lake, Man., a distance of 42 miles. Completion is expected by Dec. 1, 1929. The work will be done by the Dominion Construction Company of Winnipeg, contractor on the Flin Flon line.

Bridge or Tunnel at Norfolk Being Considered

Under authorization of the Virginia state legislature a bridge authority has been formed by the cities of Norfolk and Portsmouth, and Norfolk County, to construct a highway crossing over the Elizabeth River connecting the two cities by either a bridge or a tunnel. The total length of the crossing would be about one mile. At present publicly owned ferries are being operated across the river at a profit, but they are considered to be an inconvenience and delay traffic.

Cost estimates ranging from $4,500,000 to $6,500,000 have been presented in preliminary engineering reports. Projects for both public and private toll structures are under consideration. Up to the present time no conclusion has been reached as to the most desirable and economical type of structure, location of crossing or method of organization.

Commission to Plan Seattle Crossing Elimination

W. D. Barkhuff, city engineer of Seattle, Wash., has been elected president of a new commission composed of engineering representatives of the city and of five railroads affected by a proposed program of grade separation, the object of which will be to work out plans for grade-crossing elimination in the South End industrial district. A. F. Marion, chief engineer of the Pacific Coast Railway, was chosen vice-president, and C. W. McMorris, assistant city engineer, was elected secretary.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Boulder Dam Findings—Propose Construction Credit Reforms—Hearing on Potomac Bridge

NO OFFICIAL information has yet been given out as to the recommendations of the Boulder dam board. However, various members of Congress have read the summary submitted for the guidance of the President in the preparation of his annual message to Congress, and the discussions in which these officials have participated give indications of the findings of the board. Accordingly it can be said that the board believes it feasible to construct a high dam at the Black Canyon site, but appears to be convinced that its cost will exceed $160,000,000. Part of the addition covers changes in the structure suggested. The board is understood to feel that there is little assurance that the returns from power sales will pay for the project even if the cost of the All-American canal is eliminated.

Passage of the Boulder dam bill now seems certain. This does not necessarily mean an early start on construction, it is recognized, as injunctions are likely to be sought on constitutional grounds.

Airplanes in Engineering

An advertisement for bids for the service of an airplane has been submitted to the office of the Chief of Engineers by Major John C. H. Lee, engineer in charge of the Memphis district. Major Lee has selected this plan, it is stated, as a solution to his problem of getting around to make inspection trips in a district that is so cut up by rivers and streams that the ordinary transportation facilities do not suffice. It is practically impossible to secure the services of the government flying forces for such purposes, because of the policy adopted to encourage commercial aviation by restricting the use of army and navy planes as much as possible.

Plan to Stabilize Credits

Acting upon the conviction that a large part of the ills that beset the construction industry are traceable to loose credit practices, the Allied Construction Industries committee of the Associated General Contractors has been devoting considerable thought to devising a remedy. This remedy is now offered to the industry in the form of proposals for the establishment of local credit units. A standard set of recommendations of the procedure to be followed in the formation of these credit units has been drafted and soon will be distributed among the local groups of the industry.

The essence of this plan, it is stated, is based on the principle that the contractors should use their buying power to bring about better credit conditions. This group buying power when handled wisely by a local credit board will be more effective than legislation in suppressing unfair selling methods, it is pointed out. Although consideration has been given to the advisability of arranging for a trade practice conference under the auspices of the Federal Trade Commission, no definite steps have been taken in this direction at this time.

The plan for a standard credit system as recommended is patterned after a similar method now operated by the Association of electragists of Detroit, Mich.

Utilities and the Colleges

That co-operative studies undertaken between land grant colleges and utility interests constitute no impropriety or breach of ethics was the consensus of opinion among delegates to the forty-second annual meeting of the Association of Land Grant Colleges and Universities, which was held in Washington Nov. 20-22. In attendance were the presidents and deans of leading engineering schools. Delegates in open meeting voiced their contention that nothing they have done in that connection is properly subject to criticism.

They pointed out that it is a common practice for federal bureaus and for schools to co-operate with private interests in the study of problems which affect the public interest. The question was not made the subject of extended discussion, as the feeling was that there is nothing to explain and that "an apologist lays himself open to criticism." Comment was made to the effect that no one had anything to conceal and that the newspaper attacks and those prompted by political considerations are not worthy of formal recognition.

Plan New Potomac Bridge

In order to allow all interested parties an opportunity of expressing their views on the construction of a bridge across the Potomac 60 miles below Washington, Major Brehon Somervell, district engineer, has given notice that there will be a public hearing in Washington Dec. 6. The application for the construction of the bridge, which has been made by the George Washington-Wakefield Memorial Bridge Corporation of Richmond, is understood to have a rather uncertain prospect for approval because of the policy of the Chief of Engineers regarding bridges across the outlets of major ports.

While Washington has attained no considerable importance as a commercial port, extensive use of its water facilities is made by naval vessels and other government craft. It has been stated, in fact, that 50 per cent of the craft passing up the Potomac are government vessels. Military experts also strongly oppose any structure across the Potomac that would be a potential impediment to Washington's access to the sea in time of war.

According to the plans for the proposed bridge, the deepwater section of the river will be crossed by ten trusses from 337 to 450 ft. long, with vertical clearances above the mean high water average ranging from 36 to 135 ft. at the channel span.

Engineering Societies

CALENDAR

Annual Meetings

AMERICAN ROAD BUILDERS' ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 14-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; annual meeting, New York, N. Y., Jan. 16-18.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; annual convention, Detroit, Mich., Feb. 12-14.

THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS will hold its annual meeting at Chicago on Dec. 4 to 7. The power and machinery division, meeting Dec. 4 and 5, has on its program a lengthy symposium on new developments in combine harvesting, a discussion on "Requirements of the General-Purpose Tractor" and several papers on "Large-Scale Farming." The structures division, Dec. 6, has papers on: "Heat-Treated Aggregates for Concrete," by T. H. Merriam, Portland Cement Association; "Standardized Practice in Farm Building Construction," by Frank P. Cartwright, chief engineer, National Lumber Manufacturers Association; and "Research in Farm Structures," by Henry Giese, Iowa Agricultural Experiment Station. The rural electric division, Dec. 6 and 7, includes in its program a paper on "Installation of Water Systems," by F. W. Duffee, University of Wisconsin. The secretary of the association is Raymond Olney, St. Joseph, Mich.

THE AMERICAN ASSOCIATION OF PORT AUTHORITIES, in convention at Houston, Tex., Nov. 15, elected the following officers: President, Brig. Gen. T. L. Tremblay, general manager and chief engineer of the Quebec Harbor Commission; first vice-president, Major Gen. William L. Sibert, chairman of the Alabama State Docks Commission, and treasurer, Frank C. Marron, purchasing agent, Port of Seattle. The following were named as directors: Major Gen. Edgar Jadwin, Washington, D. C.; J. Russell Wait, Charleston, S. C.; George F. Cotterill, Seattle, Wash.; E. L. Cousins, Toronto, and Walter B. Allen, Los Angeles.

THE KENTUCKY-TENNESSEE SECTION, American Water Works Association, has changed the place of the next annual meeting to be held Jan. 24-26, 1929, from Knoxville to Chattanooga, Tenn.

THE NATIONAL HIGHWAY TRAFFIC ASSOCIATION, at its annual meeting in New York Dec. 10-12, will consider a number of subjects of interest to engineers, including: "Economic Utilization of Highways," by George H. Pride, president, Pride Transportation Company; "The Necessity of Research in the Solution of Traffic Control Problems," by H. M. Gould, consulting engineer, Detroit; "Foresight and Hindsight About Dangerous Curves and Bridges," by Arthur H. Blanchard, consulting engineer; "Problems of Efficient Street Use by Vehicles and Pedestrians," by Miller McClintock, Harvard University. Among the reports to be received are those of committees on the economic status of toll roads, traffic control on long bridges and in tunnels, illumination of highways, and elevated roadways.

THE SOCIETY OF AUTOMOTIVE ENGINEERS has decided to organize a Canadian section. Officers of the preliminary organization are: President, R. H. Combs, Prest-O-Lite Company; vice-president, A. S. McArthur, general superintendent of the Toronto Transportation Commission; secretary-treasurer, Warren Hastings.

THE DETROIT ENGINEERING SOCIETY has elected John P. Hallihan, chief engineer of the Rapid Transit Commission, as president, to fill the vacancy caused by the death of Mr. Peck. Edward M. Walker and H. L. Walton are vice-presidents, and E. L. Brandt is managing secretary.

THE PORTLAND, ORE., CHAPTER of the Associated General Contractors recently made an inspection trip to Oregon State College at Corvallis, Ore., where the members were entertained by the faculty and students. An illustrated lecture on the construction of the Burnside St. bridge was given by C. F. Swigert, president, Pacific Bridge Company, Portland, Ore.

THE ROCHESTER SECTION, American Society of Civil Engineers, and the Rochester Engineering Society held a joint meeting recently to hear Charles L. Cadle, general manager of the Rochester Gas & Electric Corporation, give an illustrated address describing his recent trip to Europe.

Personal Notes

FREDERICK E. TURNEAURE is to be the honorary guest at a dinner to be held Dec. 11 celebrating his 25th anniversary as dean of the College of Engineering, University of Wisconsin.

GEORGE E. EVANS, who has been manager of the Ontario Division of the Dominion Bridge Company for the past 31 years, has retired from active service and A. Ross ROBERTSON has been appointed manager of the division. Mr. Evans will remain with the company in an advisory capacity.

L. G. TUTTLE, for many years superintendent of the Sodus water-works, has resigned and will leave shortly for Arlington, Va., where he will spend the winter.

BENJAMIN J. DASHIELL, consulting engineer, of Baltimore, Md., has retired from active practice. Mr. Dashiell built the first electric power line in the city of Denver and has been associated with many electrical developments in this country. Other work with which he has been identified includes plants of the Baltimore Copper Works and of the Baltimore Dry Dock & Ship Building Company; gas plants at Springfield, Boston, Malden, Roxbury and Cambridge, Mass., and Indianapolis, Ind.; the largest copper-rolling mill in the country, at Buffalo, N. Y.; an electrolytic copper plant in Chile for the Braden Copper Company; and several other mining and smelting works.

FRANKLYN D. NASH sailed recently on the "Olympic" for Europe en route to Persia, where he has accepted a position as locating engineer with Ulen & Company on their Persian Railway contract. Mr. Nash's address will be care of Ulen & Company, Ahwaz, Persia.

LYNNE J. BEVAN, for twenty years with the consulting engineering firm of Viele, Blackwell & Buck, consulting engineers, New York City, announces the opening of an office as consulting engineer at 57 William St., New York City. He will specialize in hydro-electric projects, stream flow control and utilization for power or water supply, preparation of technical hydraulic evidence and appraisal of utility properties.

MARTIN A. MORRISSEY, formerly of the Massachusetts state highway testing materials laboratory, is now associated with the Thompson & Lichtner Company, Boston, Mass., in charge of its Boston testing laboratory.

O. C. ROLLMAN, construction engineer, Wisconsin State Highway Department, has resigned to accept a position with a commercial organization in Milwaukee. He started his highway training in 1914 as county highway commissioner of Shawano County.

A. L. HAMBRECHT, division engineer, Wisconsin State Highway Department, succeeds O. C. ROLLMAN, resigned, as construction engineer of the department. Mr. Hambrecht has been with the department since 1915, handling the Madison area since 1921.

G. I. GERMOND, assistant division engineer, Wisconsin State Highway Department, has been made division engineer at Superior, Wis., vice HAROLD F. HOLMES, resigned.

Obituary

JOHN A. SNYDER, retired bridge builder, died at his home in Lockport, N. Y., Nov. 21, at the age of 60 years. For 35 years he was superintendent of general construction in the western division of the New York Central Railroad. He was born in Dolphin, Pa., was graduated from the Horton School of Engineers of Philadelphia, and, previous to joining the N. Y. Central, was with the Phoenix Bridge Company of Pennsylvania. Retiring ten years ago, he had since supervised the construction of roads in Niagara County.

OLIVER AVERY HYATT, for 32 years village engineer of Scarsdale, N. Y., died Nov. 23 in that city at the age of 91.

Construction Equipment and Materials

Scrap-Iron Industry Organizes

A charter has been issued by the Secretary of State of New York to the Institute of Scrap Iron and Steel, Inc., of New York City. Among the objects of the organization, as stated in the certificate, are "to promote a high standard of business ethics in the scrap-iron and steel industry, to aid in the prevention of unfair competition and elimination of trade abuses, to prepare the scrap-iron and steel industry for mobilization in national emergencies." Among the incorporators are representatives from most of the large cities in the eastern part of the country. Louis Richman, 225 Broadway, New York City, is attorney for the corporation.

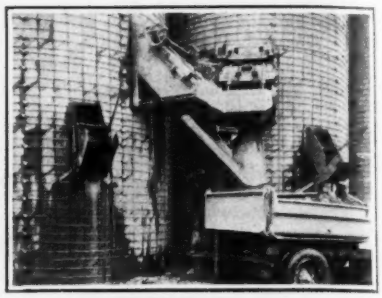
Proposed New Standards for Pipe Flanges and Fittings

A tentative American standard for 800-lb. hydraulic cast-iron pipe flanges and flanged fittings has recently been issued through the American Society of Mechanical Engineers for criticism and comment. The report is the work of a sub-committee of the sectional committee on the standardization of pipe flanges and fittings, which has completed the draft after frequent meetings throughout the country. The committee is sponsored by the Heating and Piping Contractors National Association, the Manufacturers Standardization Society of of the Valve and Fittings Industry and the American Society of Mechanical Engineers, acting under the procedure of the American Standards Association. Copies of the proposed standards may be obtained from C. B. Le Page, assistant secretary, American Society of Mechanical Engineers, New York, N. Y., who will also receive criticisms and suggestions.

New Developments

Batchmeter Designed for Use on Concrete Silos

The growing use of concrete-stave silos for the storage of aggregate in large mixing plants has led to the design by the Superior Engineering Company, Warren, Ohio, of a special

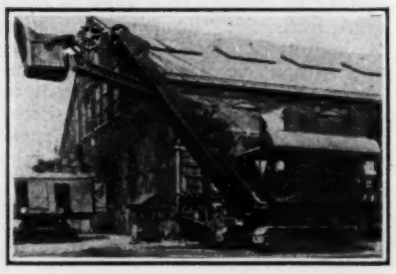


batchmeter adapted to the requirements of this type of installation. This batchmeter requires a height of only 4 ft. 8 in. from the discharge point in the silos to the point where the batchmeter discharges into the truck. Its upper and lower gates are interlocked, so that only one can be opened at a time. Proportions of the batch are regulated from the ground level by means of a chain wheel, the volume being shown from the ground by a capacity gage. Capacity varies from a minimum of 10½ cu.ft. to a maximum of 28 cu.ft. Connection to the silos is made by means of a standard gate frame. The illustration shows two of these units discharging into a common chute pivoted to permit tilting up when not in use.

Diesel-Electric Drive Included in New Line of 2-Yd. Shovels

Announcement of a new line of 2-cu.yd. shovels, known as type 480, has just been made by the Marion Steam Shovel Company, Marion, Ohio. These machines have the same general construction as the old type 37, but are heavier, more rugged and more powerful, and include several refinements in design. All models of type 480 have uniform under-frame and crawler construction; boom, handle and dipper dimensions; and can be equipped with crane, clamshell, or dragline equipment. Three different forms of primary power supply are provided: steam, electricity, and Diesel-electric. The shovel has a 25-ft. railroad-type boom of wood and steel, with 17-ft. dipper handle of the same material.

Diesel-electric drive has been used before on dredges and dragline excavators, but it is believed to be unique on shovels. A Winton-Diesel engine is direct-connected to a direct-current "drooping voltage" generator, supplying current to electric motors geared individually to hoist, swing and crowd. The Diesel engine is rated at 150 hp. at 750



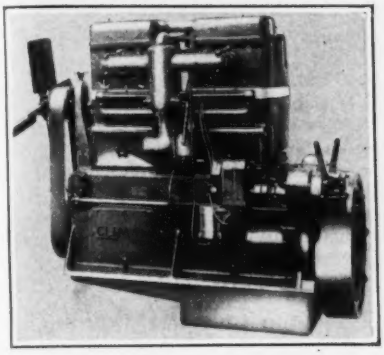
LARGEST REVOLVING STRIPPING SHOVEL NOW IN USE

This electric shovel of unprecedented size is now at work in the coal fields of Indiana. It weighs 1,788,000 lb., uses a 12-cu.yd. dipper, and has a maximum boom section of 7x4 ft. The bucket will dump at a radius of 107 ft. and height of 77½ ft. The Bucyrus-Erie Company, South Milwaukee, Wis., is the builder. Electric control is used throughout.

r.p.m. The generator is 50 kw. and the hoist motor 90 hp. (60-minute rating), while swing and crowd motors are 30 hp. The generator and motors will deliver several times their rating for short periods in typical shovel service. The Diesel is a six-cylinder, four-cycle airless injection engine with cylinders 7x8½ in. It has a seven-bearing, 4¼-in. crankshaft of nickel steel with ground journals. The starter is of the Winton make and operates at 400 lb. air pressure.

Four-Cylinder Industrial Motor Develops 110 Hp.

Designed especially for heavy-duty industrial work, a new four-cylinder valve-in-head engine known as the Blue Streak is now being produced by the Climax Engineering Company, Clinton, Iowa. The cylinders have a 6-in. bore



and 7-in. stroke and are surrounded by large water jackets to prevent the distortion of valves and valve seats. Ample hold down bolts are provided to prevent gasket trouble, and a vacuum spark control which works automatically is used to regulate the spark. The performance of the motor as shown on block tests is indicated by the following table submitted by the manufacturer:

Speed, R.P.M.	Hp.	Pounds of Fuel Per Hp.-Hr.
500	50	0.62
600	62	0.61
700	73	0.60
800	83	0.58
900	92	0.57
1,000	100	0.57
1,100	106	0.575
1,200	110	0.59

Business Notes

COWHAM ENGINEERING COMPANY, Chicago, Ill., has appointed J. L. Nelson vice-president and general sales manager.

STODDARD-DICK COMPANY, Detroit, Mich., has opened a branch office at Cleveland, Ohio, in charge of Carter G. Swift.

LINCOLN ELECTRIC COMPANY, Cleveland, Ohio, has prepared a motion picture showing the application of electric arc welding in the fabrication and erection of the structural steel for the recently completed Upper Carnegie Building, a four-story structure which was designed for arc welding and contains many new and unique features of construction. The complete story is contained in three reels of 16-mm. film which will be loaned free upon application to the company.

FEDERAL MOTOR TRUCK COMPANY, Detroit, Mich., announces that R. W. Ruddon, first vice-president, has also assumed the duties of general manager. M. L. Pulcher, formerly president and general manager, will continue as president.

SULLIVAN MACHINERY COMPANY, Chicago, Ill., has appointed the Monongahela Supply Company as its distributor at Morgantown, W. Va. R. R. Harrison is in charge. The distributor at Newark, N. J., Staats Abrams, has moved his office to Orange, N. J.

NEW READY-MIXED CONCRETE PLANT

Accurate reproduction of laboratory mixes with efficiency in labor determined the design of this concrete plant built for the Avril Tru-Batch Concrete Company, Inc., Cincinnati, Ohio, by the Blaw-Knox Company. Aggregates are stored in the four 18-ft. circular bins, each holding 196 tons, whence they are carried to a batching bin by a belt conveyor. The cement, received in carload lots, is conveyed to a cement bin by means of an inclosed bucket elevator, and from there to the batch hopper by a belt conveyor. Proportioning is done by weighing batchers. The output of the 2-cu.yd. mixer is 60 cu.yd. of concrete per hour with a crew of four laborers and a foreman.

Manufacturers and Trade Associations

CALENDAR

ANNUAL MEETINGS

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 9-11, 1929.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 14-18, 1929.

NATIONAL CRUSHED STONE ASSOCIATION, Washington, D. C.; annual convention, Cleveland, Ohio, Jan. 21-24, 1929.

New Publications

Material Handling Equipment — CLEVELAND CRANE & ENGINEERING COMPANY (electric tramrail division), Wickliffe, Ohio, has issued a complete catalog devoted to the application of the tramrail system to material handling by means of overhead trolleys. This catalog forms a practical handbook describing in detail methods of transporting materials in the various industries.

Heat Treatment—GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a bulletin, "Electric Heat in General Electric Factories," which describes the apparatus developed by the company for use in its own factories, as well as for other industries for economical electric heat treating.

Mechanical Building Equipment — WORTHINGTON PUMP & MACHINERY CORPORATION, New York City, has issued a 28-p. illustrated book describing the products of the company applicable to building installation, including pumps, air compressors, steam compressors, oil and gas engines and similar products.

Valves—MERCO NORDSTROM VALVE COMPANY, San Francisco, Calif., devotes a 142-p. illustrated catalog to describing its complete line of lubricated valves for all purposes and pressures.

Bucket Elevators—JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, has issued a new bucket elevator catalog which describes 184 bucket elevators of different styles and sizes, with capacities from 6½ to 750 tons an hour. A feature of the catalog is a list of 41 typical materials, giving the weight per cubic foot of each and designating the type of elevator best suited for use.

Air Compressors—SCHRAMM, INC., West Chester, Pa., has issued a new edition of its catalog covering air compressors, hoists and pneumatic tools. A number of photographs show these under working conditions.

Wood Preservative — CURTIN-HOWE CORPORATION, New York City, has issued a booklet entitled "A Technical Discussion on Zinc Meta Arsenite" discussing the new wood preservative developed by the Western Union Telegraph Company and handled commercially by the Curtin-Howe Corporation.

High-Temperature Insulation—CELITE PRODUCTS COMPANY, Los Angeles, Calif., has reprinted a lecture on "High-Temperature Insulation" prepared for presentation before engineering schools throughout the country. This describes how the conductivities of various materials have been determined, based on mean temperatures of test specimens, and also a new method of determining heat loss through walls. The bulletin is known as No. 104. Another bulletin, No. 108, develops the same subject as applied to industrial furnaces and ovens for heat treating.

The Business Side of Construction

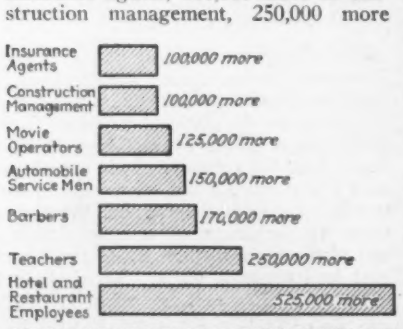
America Continues to Absorb Her Surplus Labor

The question of employment is always an absorbing topic in American business and industry. Because of the rather unexpected period of unemployment which developed last winter, a new interest has been attached to the subject. While there are still inadequate data on employment, it is certain from the fragmentary data available that the decline that has taken place during the past few years is continuing. This decline is not due to any lessening of industrial activity—in fact, the value of production since the close of the war has increased by between 30 and 40 per cent. The decreased employment in manufacturing industry may be attributed to increased efficiency in both machinery and methods of production. Since the close of the war the number of wage earners employed in manufacturing has decreased by around 660,000. It is known that there has not been an ever-increasing army of unemployed in the nation. Where, then, has this surplus labor gone?

NUMBER OF PERSONS ENGAGED IN CONSTRUCTION IN THE UNITED STATES

	1920	1928 (Estimated)
Apprentices to building and hand trades	73,953	221,859
Brick and stone masons	131,264	393,792
Builders and building contractors	90,109	270,327
Carpenters	888,379	2,665,137
Engineers (stationary), cranemen, hoistmen, etc.	279,984	839,952
Laborers, building, general and unspecified	623,203	1,869,609
Painters, glaziers and varnishers	248,497	745,491
Plasterers and cement finishers	45,876	137,628
Plumbers and gas- and steam-fitters	206,718	620,154
Roofers and slaters	11,378	34,134
Road and street building and repairing	9,558	28,674
Civil engineers and surveyors	64,660	193,980
Stone cutters	22,099	66,297
Structural ironworkers (building)	18,836	56,508
Total	2,714,514	8,143,542

It has gone in two directions. A large proportion has gone into non-manufacturing industries. To-day the Department of Commerce estimates that there are 150,000 more automobile service men than in 1920, 100,000 more insurance agents, 100,000 more in construction management, 250,000 more teachers, 125,000 more movie operators, 170,000 more barbers and 525,000 more hotel and restaurant employees. Also, as indicated in the accompanying table, a very large number of these wage earners released from manufacturing pursuits have gone into the general construction industry, the number of persons employed in construction increasing from 2,714,514 in 1920 to 8,143,542 in 1928.



THOUSANDS OF WAGE EARNERS HAVE TURNED FROM MANUFACTURING TO SERVICE INDUSTRIES SINCE 1919

Increased efficiency through the greater use of power has caused a second portion of the resulting labor surplus to go into new industries. These men are producing products undreamed of at the opening of the century, products which are recognized as absolutely essential to our modern social life—automobiles, radios, vacuum cleaners, talking machines, refrigerators, washing machines, rayon and the other products of the chemical laboratory.

Yet there is every reason to believe that we are but at the beginning of new developments and advances. It is in the manufacture of this ever-growing list of new commodities and in the increasing demand for service of all kinds that America has absorbed and will continue to absorb her surplus labor.

E. N.-R. Index Numbers

Cost		Volume	
Nov. 1, 1928	**209.46**	**October, 1928**	**363**
Oct. 1, 1928	207.71	September, 1928	296
Nov. 1, 1927	201.98	October, 1927	269
Average, 1927	206.24	Average, 1927	263
Average, 1926	208.03	Average, 1926	228
1913	100.00	1913	100

Net Profits of 392 Companies Up 10.99 Per Cent

Total net profits of 392 companies in 21 lines of industry and miscellaneous amounted to $2,268,106,000 in the first nine months of 1928, compared with $2,043,491,000 in the corresponding period of 1927, an aggregate gain of 10.99 per cent, according to a compilation compared by Ernst & Ernst, accountants, from published financial statements. Industrials lead the list with an increase of 19.17 per cent. Public utilities follow with a gain of 11.97 per cent. A group of 125 railroads report an income, before certain charges but on a comparable basis, 3.02 per cent higher than in the same nine months of 1927.

The third quarter of 1928 stands out as quite radically different from the corresponding quarter of last year. In the 1928-27 comparison for the nine months only four groups among the industrials showed declines in 1928. These are the bakeries, building equipment, cigar manufacturing and railroad equipment companies. The total of 232 industrials included in the tabulation show an increase in profits of 19.17 per cent, but of the total 163 companies reported increased profits, while 69 showed slightly lower profits than during the same period in 1927. The railroad group is nearly equally divided between the number of companies showing better profits and the number showing declines.

The Retailer's Salary

The bureau of business and government research of the University of Colorado has worked out, on the basis of recent cost studies, the minimum volume of business that will pay the proprietor of a one-man store a salary of $2,000 besides paying other overhead expenses. The minimum volume of business for various lines, together with the percentage of such volume which a $2,000 salary represents is shown in the following table:

Line	Volume to Give $2,000 Salary	Percentage of Volume Represented by Salary
Hardware	$13,423	14.9
Lumber	20,408	9.8
Clothing	14,815	13.5
Drug	12,048	16.6
General mdse.	15,873	12.6
Grocery	17,391	11.5

It is claimed that the ratio of salary to sales volume will hold also for additional help employed. The profitableness of hiring an additional clerk is said to depend upon his ability to increase the annual volume by an amount of which his salary shall represent the percentage indicated.

Gain in Industrial Building

Reports made to *Engineering News-Record* on construction contracts let during the week ended Nov. 27 indicate a material gain in the volume of new industrial building construction as compared with the same week last year. On the other hand, the week witnessed a decline under last year in volume of contracts let for commercial buildings. The total volume for the current week was about $23,000,000 under the same week last year. This drop, however, was due to two unusually heavy subway contracts let during the same week last year, totaling around $10,000,000, and also two gas pipe line contracts totaling around $36,000,000. If these unusual contracts are eliminated from last year's figures, it will be found that the current week exceeded the corresponding week of last year by about $22,000,000.

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended Nov. 27, with some comparisons, total as follows:

(In Thousands of Dollars)

	Nov. 27, 1928	Nov. 20, 1928	Nov. 29, 1927
Buildings:			
Industrial	$21,599	$4,733	$5,605
Commercial	22,181	34,094	27,120
Streets and roads	1,599	5,978	10,289
Other construction	29,088	9,574	54,426
Total	$74,467	$54,379	$97,440

Total, all classes, Jan. 1 to Nov. 20:

1928	$3,396,434
1927	2,973,362